IFAD
Investing in rural people

RURAL DEVELOPMENT REPORT 2021

Transforming food systems for rural prosperity

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Abbreviations and acronyms

AFS	agrifood system
ASF	animal-sourced foods
BaU	business as usual
DALY	disability-adjusted life-years
EU	European Union
FBD	foodborne disease
FDI	foreign direct investment
FLW	food loss and waste
GHG	greenhouse gas
GLOPAN	Global Panel on Agriculture and Food Systems for Nutrition
HLPE	High Level Panel of Experts on Food Security and Nutrition
ICT	information and communication technologies
MAGNET	Modular Applied GeNeral Equilibrium Tool
R&D	research and development
SDG	Sustainable Development Goal
SMEs	small and medium-sized enterprises
SPS	sanitary and phytosanitary
UPF	ultra-processed food
WHO	World Health Organization
WTO	World Trade Organization

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President's Foreword

Food is our most essential need. Food systems – the production, processing, retailing and delivery of food, consumer dietary preferences, disposal of what remains of food consumed and produced – affect the global economy, the global environment, and every person on the planet. Food systems are also a key element in delivering on the Sustainable Development Goals. Yet, despite unprecedented economic growth, progress in calorie production and reductions in food insecurity in recent decades, food systems as they now operate – globally, nationally and locally – are failing to deliver desired outcomes for the climate, for the environment, for nutrition and human health, and for social welfare.

The transformation of food systems is a burning topic across the globe, in response to concerns about the nutritional, environmental and equity impacts of our current system. Food system transformation is inextricably linked with efforts to eradicate hunger and poverty, since the livelihoods of a large share of the world's poor people are based upon such systems and we cannot afford to leave rural people behind. This is why IFAD's *Rural Development Report 2021* is focused on rural livelihoods in the context of food systems transformation.

The report promotes equitable livelihoods for rural people, who are front and centre in transforming food systems, alongside the need to improve nutrition and protect the environment. The global need for more nutritious food, ecosystem services and a low-carbon economy also offers the potential for new and innovative livelihood opportunities.

The *Rural Development Report 2021* was prepared by IFAD working in close collaboration with Wageningen University over a two-year period. It also presents novel results of a global quantitative modelling exercise that simulated the impacts of various types of transformative changes on a range of environmental, social, economic and nutritional indicators. These analyses were informed and enriched by regional consultations and interviews with experts.

The report analyses the issues arising in different segments of the food system (consumption, production and midstream) in relation to the lives of poor rural people, identifying potential entry points for positive change. It envisages the overall goals of a food system's transformation as ensuring that people are able to consume diets that are healthy, to produce food within

planetary boundaries and to earn a decent living from their work within food systems. Central to these goals is the need to ensure that food systems are resilient to shocks – to the pandemic we are currently facing, to climate change, and to other threats.

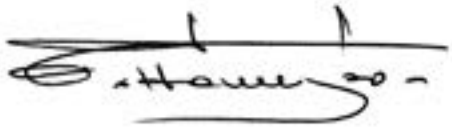
Also key will be a focus on food systems at local levels. This means connecting dynamic small-scale farms with value-addition activities across food systems to promote a more diversified range of livelihoods for rural people. Strong rural-urban linkages, territorial development, enabled by digital connectivity, will be essential.

Entrepreneurial capability, business support and private sector partnerships will be crucial in all of this – as will be targeted approaches to ensure the inclusion of women, youth and indigenous peoples.

The changes required to achieve our goals are far-reaching. Systemic change will be needed to reshape the deeper structural inequalities that constrain the livelihoods of rural people. Transforming food systems in a way that breaks down these barriers will necessarily challenge established assumptions, mindsets, procedures, political and economic interests, and power relations. Such change can happen only with extraordinary collaboration, coordination and communication across sectors, and across governments, development partners, the private sector, civil society, rural people's organizations and the scientific community.

The United Nations Food Systems Summit provides a platform where we can work together to achieve lasting change. As the *Rural Development Report* is launched on the precipice of this Summit, it is my hope that the lessons herein can contribute to the implementation of the commitments that will emerge from the Summit as a shared global agenda for transforming our food systems.

The global reality we face today is more complicated and challenging than any most of us can remember. Yet, we also have a historic opportunity to come together and transform our food systems in a way that will improve the lives of people today and tomorrow. This must be the pathway for achieving the Sustainable Development Goals and for realizing the future we want.

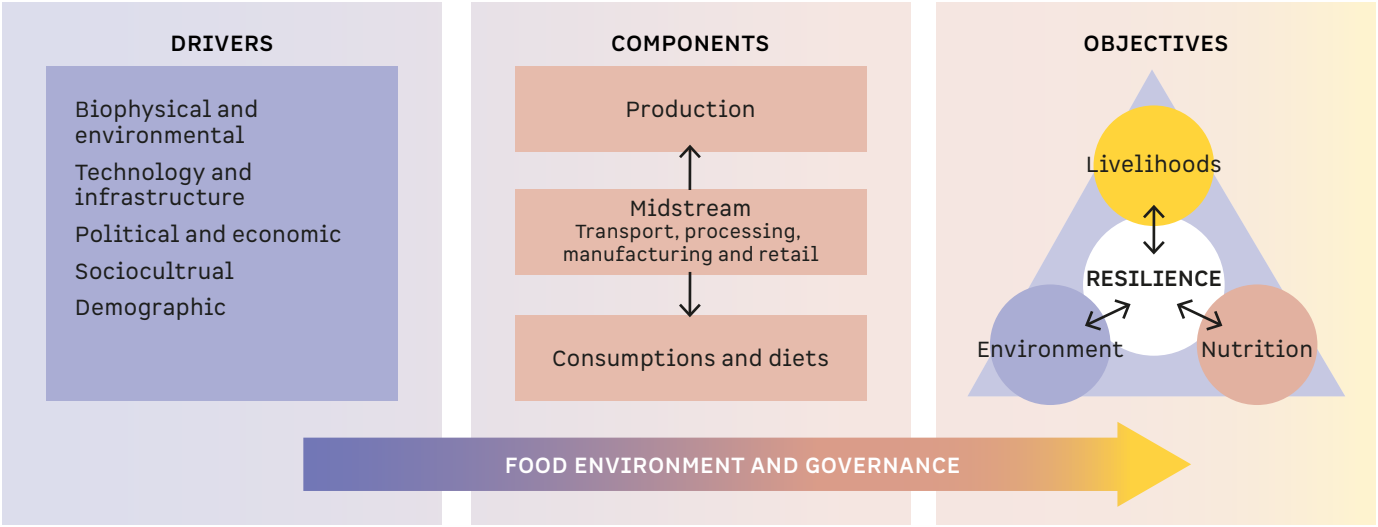


GILBERT F. HOUNGBO
President of IFAD

Readers' guide

The *2021 Rural Development Report* analyses the linkages between the prosperity of rural people and the transformation of food systems. Small-scale farmers, rural workers and entrepreneurs produce, process and distribute much of the world's food, yet many are unable to earn a decent living. The report examines how opportunities in the food system can generate more diversified and equitable outcomes.

The report distinguishes drivers, components and outcomes of food systems that interact against a backdrop of the wider food environment. It takes as its starting point the desired outcomes of food systems. The central challenge in transforming food systems is to optimize nutrition, livelihoods and environment while ensuring resilience. There are critical trade-offs to be navigated, most notably among keeping nutritious diets affordable, paying the true environmental costs of production and distribution, and enabling those who produce food to earn a decent living.



Source: Adapted from the High Level Panel of Experts on Food Security and Nutrition, 2017.

The analytical lens is rural livelihoods. While recognizing that nutrition, environment and resilience outcomes are equally important, the report pays specific attention to the livelihood outcomes of food systems. The vision is one of change driven by a new generation of rural agrifood entrepreneurs – young women and men who use their innovative energy, digital skills and voice to capitalize on opportunities, helping to drive rural prosperity for all.

Transforming food systems is a long-term generational endeavour. Looking back a generation, food systems have since changed beyond recognition. Global agricultural output has risen enormously, and hunger has come down sharply. Yet, paradoxically, as the efficiency of food production increased, well-intentioned food and agricultural policies generated incentives, externalities and spillovers that have led to poor nutrition, environmental decline and rural inequality. The challenge for this generation is to recognize the interlinkages within food systems, to make explicit trade-offs between desired outcomes, and to avoid unintended and uncompensated costs and consequences. Choices today will determine how food systems transform for decades to come, so breaking the intergenerational cycle of poverty, hunger and malnutrition needs to start now.

The pathways to transform food systems vary in different food environments. They vary in the physical, economic, political and sociocultural contexts in which consumers engage with the food system and acquire, prepare and consume food. The ways that food systems function vary substantially across different geographies, different market segments and the political economy of different countries. Food systems range from the localized and traditional with informal markets to the consolidated supermarket-driven model of high-income countries. Rural prosperity is inextricably connected with the way the entire food system functions – from the local to the global level.

Food systems are in continuous flux caused by external drivers that shape the pace of and potential for success. The High Level Panel of Experts on Food Security and Nutrition in 2017 identified five main categories of drivers of food system changes. Biophysical and environmental drivers include natural resource and ecosystem services, and climate change. Political and economic drivers include leadership, globalization, foreign investment and trade, food policies, land tenure, food prices and their volatility, and conflicts and humanitarian crises. Sociocultural drivers include culture, religion, rituals, social traditions and women's empowerment. And demographic drivers include population growth, changing age distributions, urbanization, migration and forced displacement. The relative impact of each driver depends on the type of food system in question, the type of actors involved, and the type of actions and policies decided upon.

Food system components include the production and consumption of food as well as the food system midstream – the vast network of agrifood enterprise activity between the farmer's gate and the consumer's plate. Agriculture and food production shape food consumption and diets, particularly for those who consume food they produce themselves. But changes in rural and urban diets and in food consumption patterns drive changes in agriculture and food production. The food system midstream connects producers and consumers and includes all the economic activity associated with transporting, processing, storing, packaging and recycling, along with support services such as finance, machinery and advice.

Reading this report

The Overview pulls together the analyses in the three parts, with a focus on rural prosperity in the wider context of transforming food systems. It starts with a focus on livelihoods and the linkages with resilience, nutrition and environment. It defines pathways to realize diversified and equitable rural livelihoods in an inclusive agrifood economy. It highlights the essential role of diversifying livelihoods across productive farming, off-farm employment and enterprises, and that of social protection. And it discusses how the foundations for change need to be aligned so that rural people can escape poverty by benefiting from opportunities in food systems.

The Overview pulls together the analyses in the three parts, with a focus on rural prosperity in the wider context of transforming food systems.

Part A zooms in on food consumption. Chapter 1 on food consumption patterns and preferences analyses the nutrition constraints of current food systems and identifies changes that will induce a healthier food supply tailored to consumer demand for more nutrient-dense foods. Chapter 2 explores animal-sourced foods, their critical role in the nutrition and livelihoods of poor rural communities, and the health and environmental impacts when they are heavily consumed by all of society.

Part B zooms in on food production. Chapter 3 on food production structures and dynamics considers how to integrate smallholders into efficient, larger value chains and how to diversify and improve small-scale agriculture towards knowledge-based, sustainable production methods that produce more diverse and nutrient-dense foods. Chapter 4 delves into how climate change, the environmental footprint and food loss and waste can be tackled through circular systems.

Part C zooms in on the food system's midstream. Supporting small-scale enterprise and entrepreneurship in the midstream and on the farm is essential for unlocking inclusive economic opportunities in the food system. Chapter 5 focuses on how trade and markets can be transformed into a driver rather than an obstacle for inclusive and sustainable food systems, exploring trade-offs between trade openness and food system resilience and describing the role of standards compliance and the incorporation of externalities into trade regimes. Chapter 6 shows how the ongoing expansion and transformation of small and medium-sized enterprises in the midstream of food systems can contribute to livelihoods and food quality, safety and diversity, as well as providing market linkages for sustainable agricultural production. Chapter 7 looks at how processing foods, and especially local food processing, can contribute to livelihoods and nutrition in a responsible manner.

The report includes an annex that shows the impact of various policy measures on food system outcomes using a scenario analysis for 71 low- and middle-income countries. The 2050 horizon of the scenarios underlines the generational nature of transforming food systems. The impact of different interventions on 28 outcome indicators – seven each for inclusiveness, nutrition, economy and sustainability – illustrates the trade-offs in deciding food policy measures and the imperatives of considering a wide range of outcomes. The scenarios thus ensure a broad focus on outcomes while diving more deeply into individual food system components. A methodological annex with graphs and data from the Overview expands on key topics presented in the report.

The report also draws on empirical evidence from field surveys, reviews and case studies. An extensive survey of 621 stakeholders from 32 countries assessed the importance of various food system deficiencies and the potential of specific interventions for particular local interest groups. Stakeholders from different backgrounds participated in expert seminars to exchange views on strategic policy priorities for desirable food system transformation. And case studies of IFAD-financed projects and evidence from empirical studies illustrate and support the analyses throughout the report.

The report also draws on empirical evidence from field surveys, reviews and case studies.

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Overview

The Overview pulls together the analyses in the three parts with a focus on rural prosperity in the wider context of transforming food systems. It starts with livelihoods and the linkages with resilience, nutrition and the environment. It defines pathways to realize diversified and equitable rural livelihoods in an inclusive agrifood economy. It highlights the essential role of diversifying livelihoods across productive farming, off-farm employment and enterprises, and social protection. And it discusses how the foundations for change need to be aligned so that rural people can escape poverty by benefiting from opportunities in food systems.

The overall goals of a food system's transformation are to ensure that people are able to consume diets that are healthy, to produce food within planetary boundaries and to earn a decent living from their work in the food system. Livelihoods, nutrition and environmental goals are interlinked. Central to these desired outcomes is the need to ensure that food systems are resilient to shocks from weather extremes, pest and disease outbreaks, climate change and market anomalies.

Rural people's livelihoods have diversified rapidly in recent decades. While most rural households still farm, many now combine farming with other sources of income to meet their needs. This diversification includes

labouring on other farms, operating a wide variety of small and medium-sized enterprises (SMEs) in the agrifood sector or wider economy, salaried employment, and remittances from family members who have migrated to urban areas or abroad. Poorer households may also benefit from social protection. Many small-scale farmers also farm alongside their other non-farm income-earning activities. The most marginalized – including female-headed households, youth and indigenous peoples – are often landless and depend entirely on non-farm income.

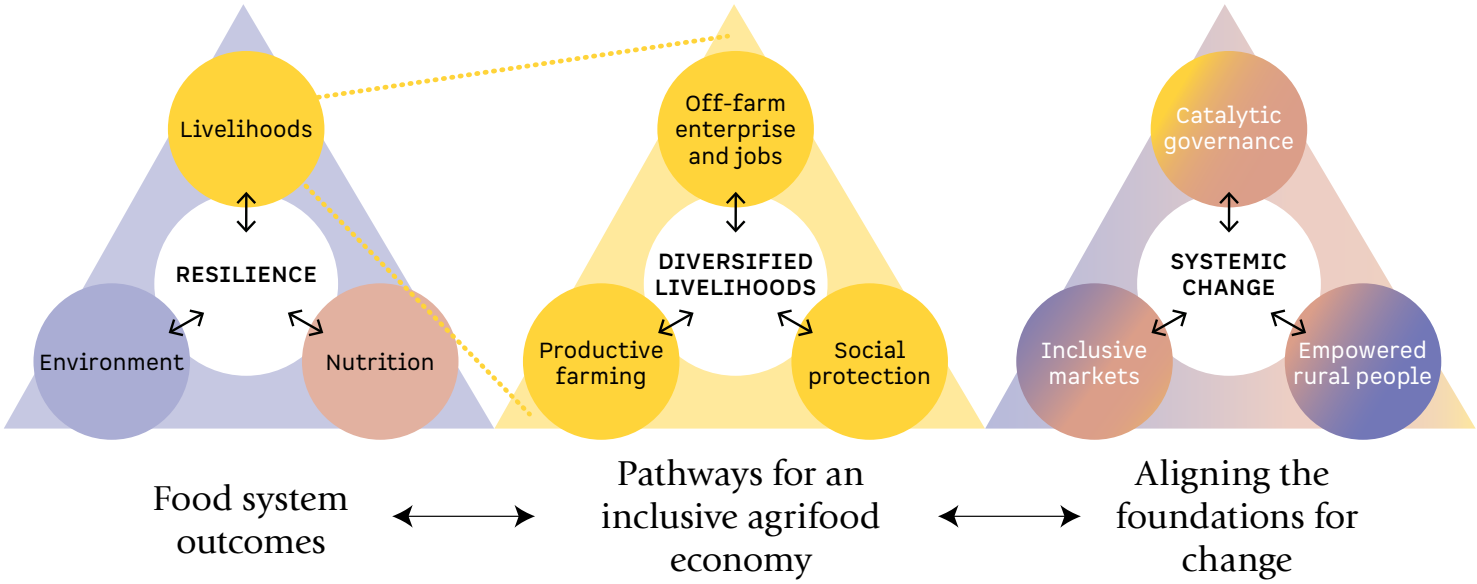
The required changes are far-reaching. The global agenda for transforming food systems can help rethink pathways out of rural poverty and inequality. Systemic change will be needed to reshape the deeper structural economic, political and cultural factors that inhibit equitable livelihoods for rural people, and that inhibit the creation of a healthy and sustainable food system. Transforming food systems will challenge established assumptions, mindsets, procedures, political and economic interests, and power relations. Deep policy reform and substantial investment will be needed. Such change can happen only with extraordinary collaboration, coordination and communication across sectors, and across government, business, civil society, rural people's organizations and the scientific community.

Small-scale farmers, agrifood entrepreneurs and rural workers produce, process and distribute much of the world's food. Yet many are unable to earn a decent living. The *2021 Rural Development Report* examines how a more inclusive food system can generate equitable and diversified rural livelihoods on and off the farm. It emphasizes the untapped potential of the food system midstream – the vast network of agrifood enterprise activity between the farmer's gate and the consumer's plate. Supporting small and medium-sized enterprises (SMEs) and entrepreneurs in the midstream will be essential for unlocking inclusive economic opportunities across the food system.

The framework of this Overview has three pillars (**FIGURE 1**):

- **Outcomes** to transform food systems so that they provide nutritious food and decent livelihoods, protect the environment and are resilient to shocks.
- **Pathways** to realize diversified and equitable rural livelihoods in an inclusive agrifood economy.
- **Aligning the foundations for change** so that rural people can escape poverty by benefiting from opportunities in the food system.

FIGURE 1 TRANSFORMING FOOD SYSTEMS FOR EQUITABLE AND DIVERSIFIED RURAL LIVELIHOODS



The global agriculture, food and beverage sector, with associated services, is worth about US$10 trillion (FOLU, 2019). In low- and middle-income countries, the agrifood sector is growing rapidly as populations increase, urbanize and become wealthier (FAO, 2017; FAO et al., 2017). In Africa, for example, the agribusiness sector is projected to triple between 2014 and 2030 to reach a value of US$1 trillion (World Bank, 2013). The share of farming in economies falls as countries grow richer and employment diversifies – and people become willing to pay for healthier diets and environmental services. More of this economic value can be created and captured in rural economies to drive diversified and equitable livelihoods there.

Small-scale family farmers are still the foundation of food supply across all low- and middle-income countries. They play a critical role in reducing rural poverty and ensuring national food and nutrition security. Investing in and creating the conditions for productive, economically viable and environmentally sustainable small-scale family farming must be at the core of the agenda to transform food systems.

However, many small-scale farmers are unable to earn a decent living from farming alone due to their very small plots of land, low prices for produce, deteriorating environmental conditions, low productivity and poor market access (Woodhill, Hasnain and Griffith, 2020; Giller et al., 2021). There are also millions of landless rural labourers, often the most destitute in rural areas. And for many countries, a rapidly expanding rural youth population has aspirations for a rewarding livelihood but faces increasing difficulty accessing land as populations increase (IFAD, 2019). Consequently, overcoming rural poverty and inequality to achieve the Sustainable Development Goals will depend on the potential of food systems to grow rural economies and generate diversified and equitable livelihoods (FAO, 2017; IFPRI, 2020). Innovation and entrepreneurship in the food system midstream will be key to realizing this potential through expanding market opportunities for farmers and generating increased off-farm livelihood options.

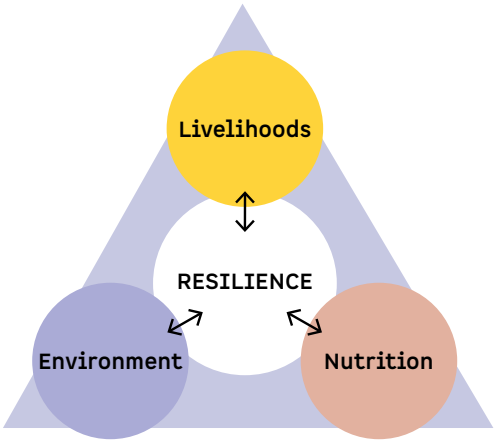
An inclusive approach to transforming food systems requires close attention to the diversity of rural people's contexts, circumstances, vulnerabilities and opportunities. Rural poverty and inequality are easily overgeneralized. Rural people are often assumed to be predominantly small-scale farmers, and the diversity of small-scale agriculture is oversimplified. Further, the disadvantages and vulnerabilities of women, youth and indigenous groups are insufficiently understood (Davis, Lipper and Winters, 2021). The diverse experiences of rural poverty have implications for the nature and scale of the challenges, the types of innovations and solutions that can work, and the data and evidence needed for tailored responses.

Equitable livelihoods are not just about income. Rural people earn their incomes from producing food and are consumers of food. Their livelihoods and health depend on earning a fair income from the food system, and on purchasing nutritious food at affordable prices, leaving them enough money to pay for other costs of living. Equitable livelihoods also means leaving no individual or group behind and investing in the fabric of social cohesion. This

requires focusing on the empowerment of women and girls, and the needs of minority groups and indigenous peoples. Rural women, men and youth must be agents of their own destiny – equipped and empowered to seek out, take up and benefit from opportunity and to have an influential voice in decisions affecting their future.

Food system outcomes

The overall goals of a food system's transformation are to ensure people are able to consume diets that are healthy, to produce food within planetary boundaries and to earn a decent living from their work in the food system. Livelihoods, nutrition and environmental goals are interlinked. Central to the desired outcomes is the need to ensure that food systems are resilient to shocks from weather extremes, pest and disease outbreaks, climate change and market anomalies.



Food system outcomes

Past food and agricultural policies, though well intentioned, have generated incentives, externalities and spillover effects that are driving poor nutrition, environmental decline and rural inequality. Since the 1960s, food systems have changed beyond recognition (Alexandratos and Bruinsma, 2012). As the global population rose by 142 per cent between 1961 and 2016, average cereal yields increased by 193 per cent and calorie production by 217 per cent (Benton and Bailey, 2019). Hunger decreased sharply. Yet, paradoxically, as the efficiency of food production increased, the efficiency of food systems in delivering nutritious food declined (Benton and Bailey, 2019). Today's food systems are failing to provide decent livelihoods for many of those who work within them. Yield growth has been accompanied by unsustainable environmental degradation.

Ignoring the interlinkages between these dimensions of food systems produces unintended and uncompensated costs and consequences. Critical trade-offs must be navigated, including between keeping food affordable for all, improving nutrition, paying the true environmental cost and enabling those who produce food to earn a decent wage (OECD, 2020a).

The nature of food systems and the ways in which they function vary substantially across different geographies, different market segments and the political economies of different countries (**TABLE 1**). They range from localized traditional systems with informal markets to the consolidated supermarket-driven model of high-income countries. Such differences greatly influence the level of agricultural employment, the role of small-scale producers and the way the midstream functions, with significant implications for livelihood opportunities.

TABLE 1 TYPES OF FOOD SYSTEMS AND IMPLICATIONS FOR RURAL WELL-BEING

FOOD SYSTEM TYPE	DESCRIPTION	IMPLICATIONS FOR RURAL LIVELIHOODS AND WELL-BEING
Traditional	– Food produced and consumed locally, traded through informal open markets with no formal contracts – Value chains are short, few food quality and safety standards – Little consumption of processed foods – Agricultural production predominantly by small and very small farms – Agricultural productivity low but employment high	– Low farm incomes; high household dependence on farm income – High levels of poverty and food and nutrition insecurity – Limited off-farm employment opportunities – Constrained access to markets for inputs and outputs
Diversifying	– Expanding network of SMEs in food value chains serving urban food demand – Trade is largely informal and dominated by spot markets – Urban retail largely through wet markets – Emergence of standards and formal contracts for some trade – Increased consumption of processed foods – Increase in food imports competes with local production – Some specialized production for export markets – High employment in agriculture and midstream, with labour-intensive technologies	– Agricultural growth driven by urban food demand – Rapid expansion of employment and enterprise opportunities in midstream dominated by SMEs – Extreme poverty and malnutrition decline – Employment conditions highly variable and open to exploitation – Diversification of rural livelihoods – Dietary transition leads to an increase in overnutrition and non-communicable disease
Consolidating	– Food system industrialized and highly concentrated – Supermarkets dominate retail – High consumption of processed and packaged foods – Global procurement of food – Public and private standards influence all aspects of production, processing and retail – Small number of firms dominate midstream and retail – Complex contractual arrangements – Food system activities are highly mechanized, capital-intensive and low in employment opportunities	– Informal sector opportunities for small-scale producers decline – Opportunities limited to those who can meet stringent standards and supply at scale – Reduced employment opportunities, but regulated labour conditions – Agricultural production often reliant on migrant workers – Substantial price competition in global food market – Increased consumption of high-energy processed foods – Rapid rises in obesity and diet-related poor health

Note: Draws on classifications by Reardon et al. (2019) and the Food Systems Dashboard. Terminology has been changed to avoid the connotation that food systems typical of high-income, industrialized countries, often referred to as "modern", are necessarily more desirable.

Resilience: Reducing risk and anticipating and recovering from shocks

Risk and uncertainty are inherent to food systems. Risks include incremental change processes (such as climate change, urbanization, evolving global trade regimes), infrequent catastrophic shocks (such as natural disasters, financial and political crises), and unexpected responses of food systems to these processes and events.

Global food security is at risk from the potential for multiple breadbasket failures due to drought, widespread disease and pest outbreaks, and price hikes in global markets (Tendall et al., 2015). Climate change only increases the risks (IPCC, 2019). There is a need to prepare for the risk of concurrent crises affecting the entire global food system and for severe crises that affect localities or regions. The coronavirus disease (COVID-19) pandemic, locust outbreaks and drought across East Africa and the food price crisis of 2008 underscore the vulnerability of food systems (Béné et al., 2021).

Poor people are highly vulnerable to food system shocks (Béné et al., 2021). By definition, poor people have few assets or savings to fall back on. So even minor shocks can push them into destitution. Vulnerability to shocks makes rural people poor, keeps them poor, and prevents them from moving out of poverty. Illness can have major effects on the household through direct and indirect impacts on family labour. Small-scale farmers rely heavily on rainfed agriculture, so flash floods, or even a short spell without rain, can cause harvests to fail, resulting in hunger and a lack of money for school or seeds for the next growing season. Chronic underinvestment in infrastructure, such as water storage, irrigation and food storage, leaves smallholder farmers particularly vulnerable.

When shocks occur, people turn to a range of coping strategies, often incurring debt or selling assets, leaving them ever more vulnerable to future shocks. As low-income rural households decide how to allocate and use cash, land and labour, they generally consider not only the available opportunities, but also the need to minimize exposure or vulnerability to shocks. And they are acutely aware that one slip could send them deeper into poverty, and so may be reluctant to engage in the higher risk, higher return activities that could lift them out of poverty.

A food system approach has to recognize that risks can be reduced but not eliminated. Risks can be reduced by investing in climate mitigation and adaptation, new crop varieties, water management and early warning systems for food shortages and pest and disease outbreaks. Food system transformation needs to create built-in capacities to mitigate the immediate effects of shocks and then rapidly recover.

Risk and resilience are at the core of the vision of rural food system entrepreneurship presented in this report. At its heart, entrepreneurship is about making investments and taking risks with the intention of generating a worthwhile benefit. Reducing risks and enhancing resilience are thus key to fostering the development of viable small-scale enterprise and entrepreneurship.

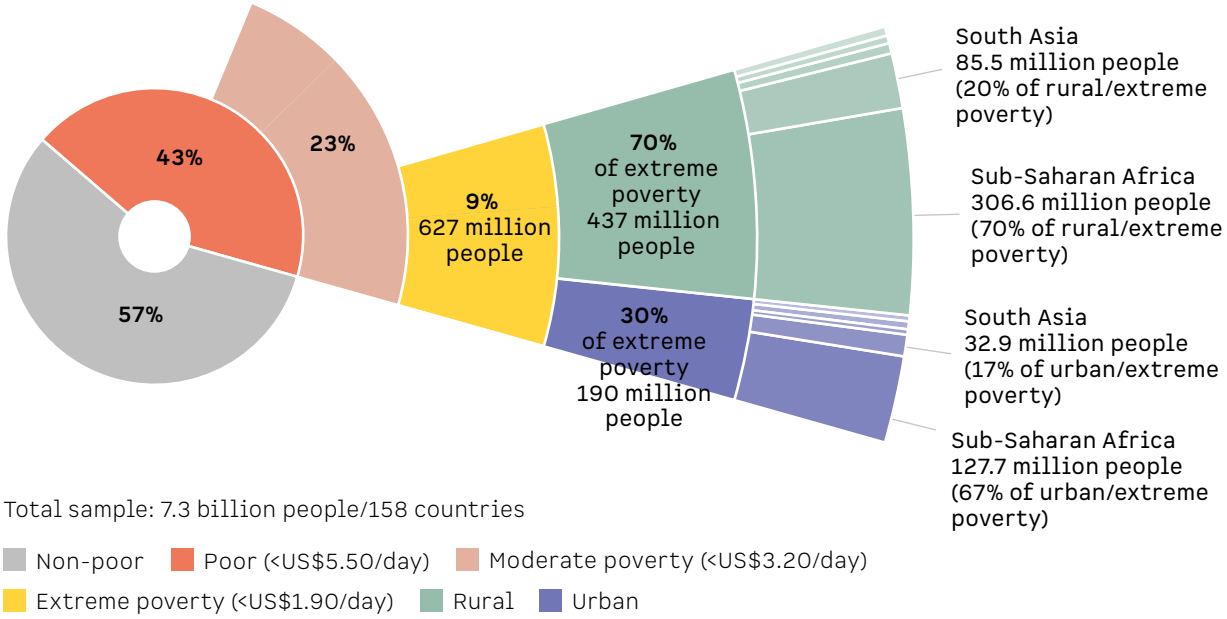
Livelihoods: Overcoming rural poverty and inequality

The livelihoods of vast numbers of rural people are connected with food systems. In low- and middle-income countries, nearly 3.2 billion people live in rural areas, and most still depend to varying degrees on agriculture and food systems for their livelihoods. Relative to other sectors, the agriculture and food sectors are unique in their scale of employment and their scale of reliance on SMEs. That is why food systems are so critical for tackling poverty and equitably distributing economic opportunity (FAO, 2017; IFPRI, 2020).

The long-term goal for shared prosperity and rural development must go well beyond just lifting people out of extreme poverty (World Bank, 2018). Globally, 627 million people still live in extreme poverty, on less than US$1.90 per day, while more than 3 billion are poor relative to the World Bank poverty rates for lower-middle- and upper-middle-income countries (**FIGURE 2**). Most poor people live in rural areas (**FIGURE 3**) and most earn their incomes, at least in part, from working in the food system.

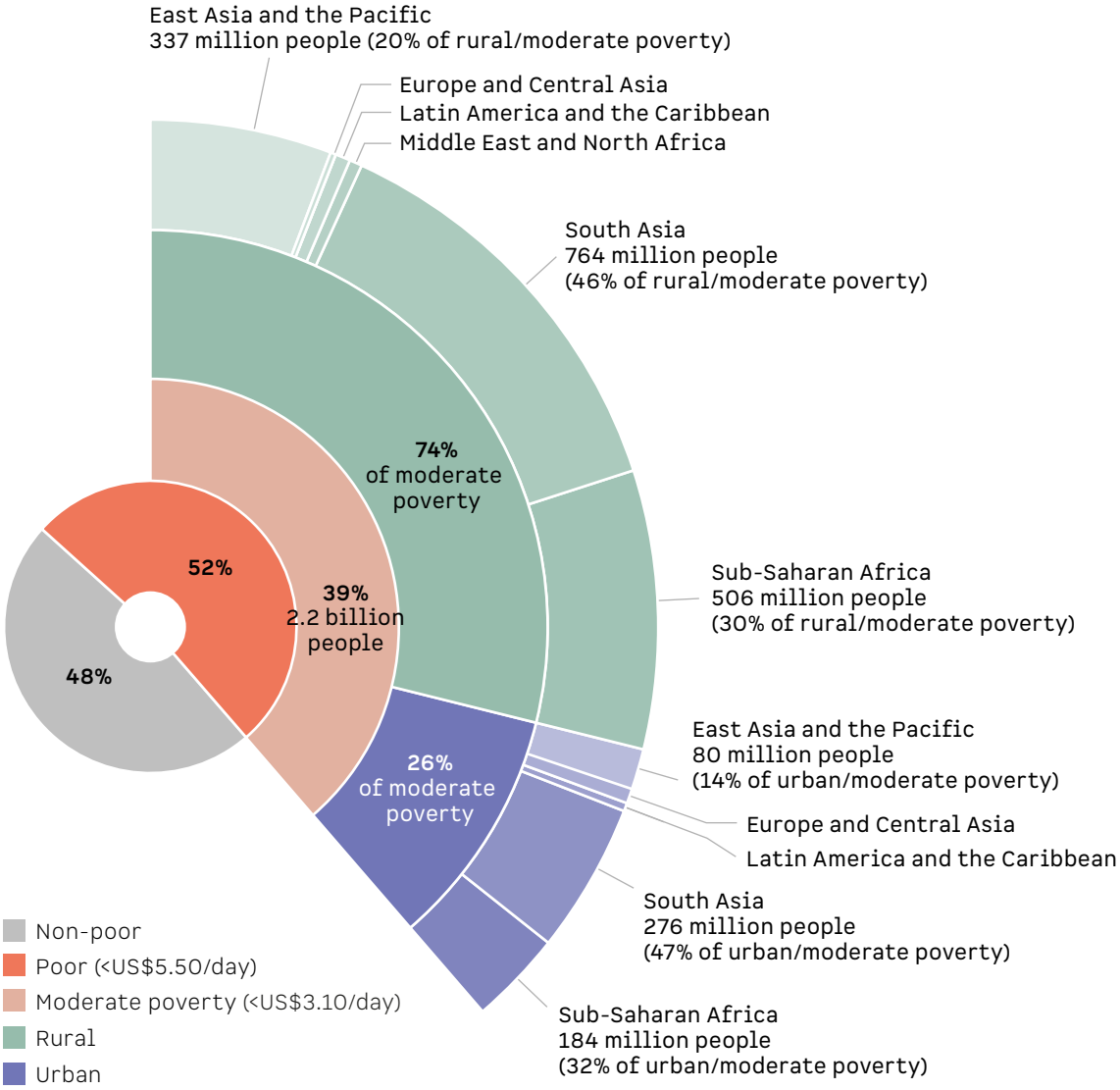
Extreme poverty rates are projected to drop to around 7 per cent of the global population by 2030, with 90 per cent of the extremely poor living in sub-Saharan Africa. Extreme poverty and hunger will also be increasingly concentrated in fragile countries. Moderate poverty will remain high across Asia and sub-Saharan Africa and will be predominantly in rural areas (**FIGURE 3**).

FIGURE 2 EXTREME POVERTY IS BECOMING CONCENTRATED IN RURAL AREAS, PARTICULARLY IN SUB-SAHARAN AFRICA



Source: Authors' elaboration using information from the World Poverty Clock and PovcalNet (http://iresearch.worldbank.org/PovcalNet/povDuplicateWB.aspx).

FIGURE 3 MODERATE RURAL POVERTY AND INEQUALITY REMAIN HIGH ACROSS EAST ASIA AND THE PACIFIC, SOUTH ASIA AND SUB-SAHARAN AFRICA, PREDOMINANTLY IN RURAL AREAS



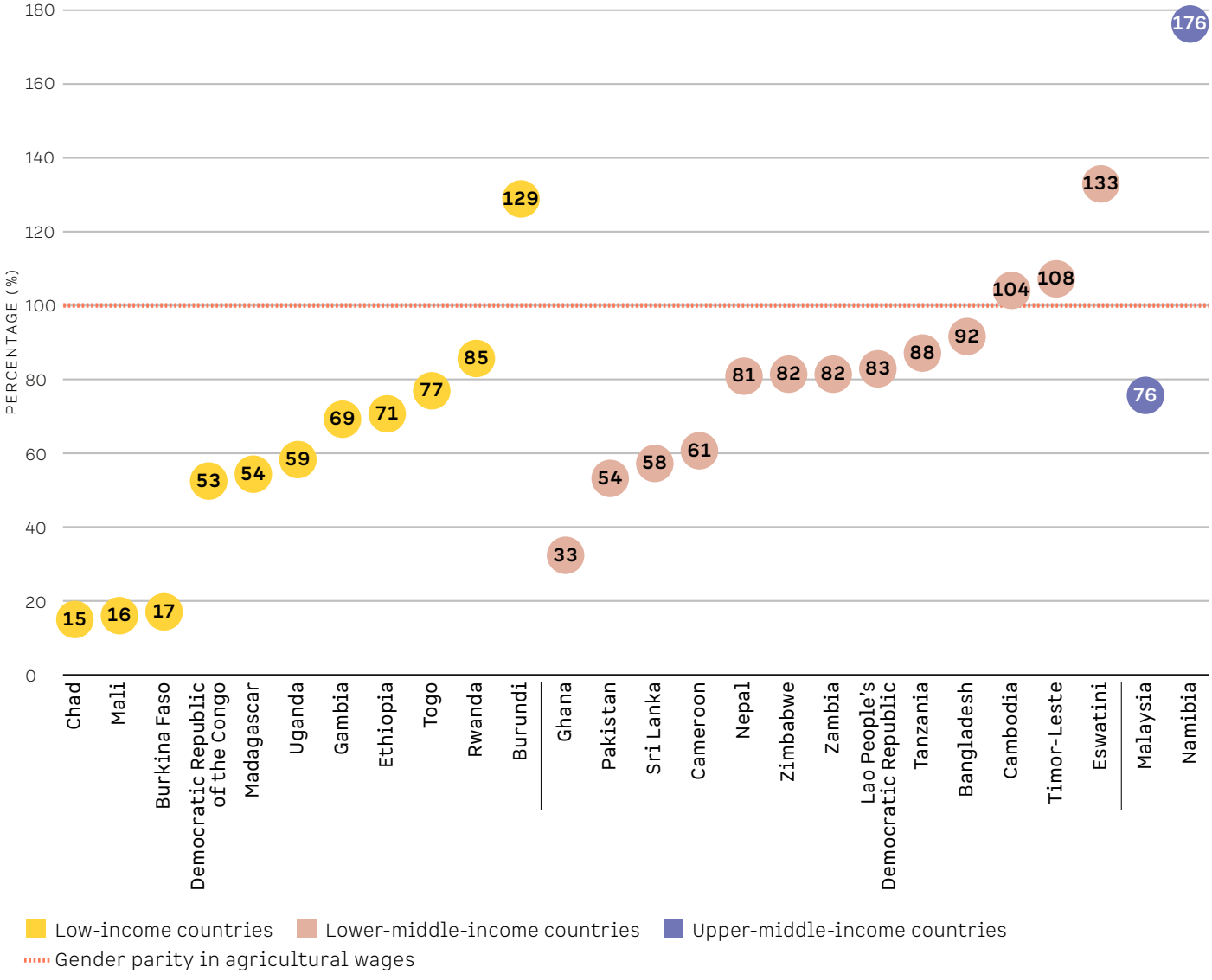
Source: FAO (2017) for moderate poverty and PovcalNet for poverty at US$5.50 per day (http://iresearch.worldbank.org/PovcalNet/povDuplicateWB.aspx).

A focus on entrepreneurship for enhancing equitable rural livelihoods will work for all only if accompanied by ambitious strategies for gender equality and women's economic empowerment. Gender inequalities in education, jobs, wages, physical safety and time poverty remain deeply embedded in rural societies (Commission on the Status of Women, 2018) and in how food systems function (Quisumbing et al., 2021). A substantial rural wage gap between rural women and men persists (**FIGURE 4**). Not only does this impact the rights of women and girls and diminish their life opportunities, it also represents a vast lost opportunity in terms of what women can contribute to economic progress in rural areas.

Indigenous communities make up 6 per cent of the global population but 18 per cent of the extreme poor, mostly in rural areas. They are the custodians of 80 per cent of the world's remaining biodiversity, and often their territories coincide with the best-preserved areas (Garnett et al., 2018). They often face discrimination and are deprived of their lands (ILO, 2020). Transforming food systems must take into account the needs of indigenous groups. At the same time, indigenous peoples have much to offer in helping to transform food systems, as their food systems represent a treasure trove of knowledge that contributes to health and well-being, benefiting communities, preserving a rich biodiversity and providing nutritious food.

FIGURE 4 AGRICULTURAL WAGE GAP FOR WOMEN – SUBSTANTIAL AND PERSISTENT

PROPORTION OF MALE AGRICULTURAL WAGES EARNED BY WOMEN



Source: ILO, 2019.

Youth-centred rural transformation needs to focus on connectivity to markets, information and social networks, productivity in education, skills and access to productive resources, and agency in civic and political participation and empowerment (IFAD, 2019). The current global rural youth population is 780 million if peri-urban areas are included, with 65 per cent in Asia and the Pacific and 20 per cent in sub-Saharan Africa. Demographic trends in sub-Saharan Africa mean that annual newcomers to the workforce will rise from 20 million today to 50 million by 2050. The rapidly growing numbers of rural youth in Africa present a huge employment challenge. Without employment opportunities, a whole generation will not escape poverty, with significant implications for rural well-being and social and political stability. Off-farm opportunities in food value chains and supporting services can provide attractive options for youth to engage in entrepreneurial activity that use their interest in digital technologies and offer the potential for a decent income.

Nutrition: Realizing a double dividend for rural people

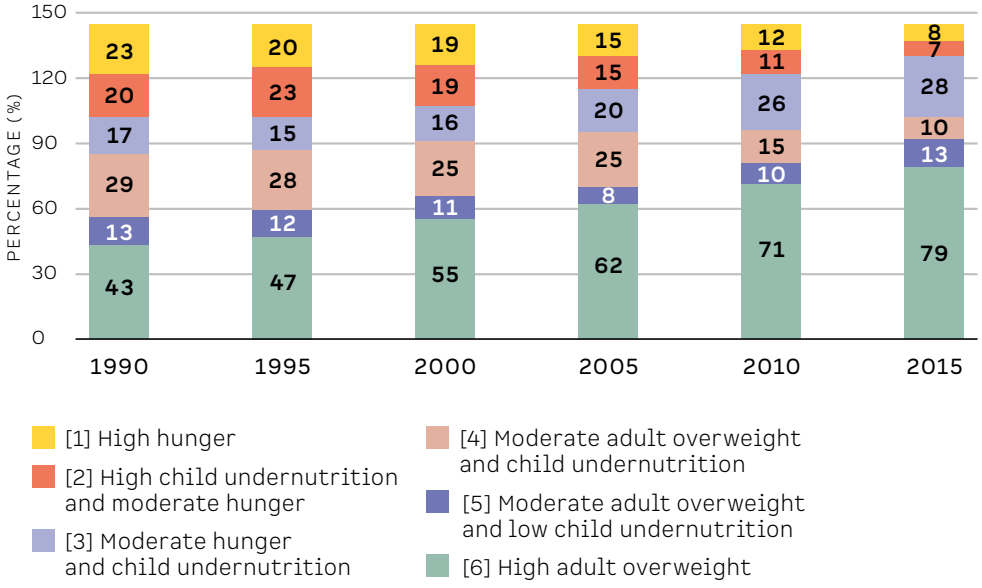
The world is facing a triple-burden nutrition crisis (Willet et al., 2019; FAO et al., 2020; GLOPAN, 2020). Continuing undernutrition, escalating overnutrition and high micronutrient deficiency can be resolved only if people produce and consume a more diverse and nutrient-dense diet. An ambitious focus on improving the nutrition of both rural and urban populations has a potential double dividend for rural livelihoods. Producing greater volumes of higher value fruits, vegetables and protein can drive growth in the rural food economy. In turn, this can contribute to rural households being able to access and afford more nutritious food – improving their health, productivity and quality of life.

Hunger and food insecurity are on the rise for poor rural people. Following decades of decline, the number of hungry people is up 181 million in the last six years to a total of up to 811 million (FAO et al., 2021). COVID-19 is predicted to push a further 100 million into poverty and hunger and reverse progress on the Sustainable Development Goals (World Bank, 2020a). Critically, more than 3 billion people, mainly in Africa and Asia, are unable to afford a healthy diet (GLOPAN, 2020; Herforth et al., 2020).

Rural and urban diets are changing substantially. Over the last 25 years, a substantial reduction in hunger and undernutrition has been accompanied by a dramatic increase in overnutrition and obesity (**FIGURE 5**). For many low-income countries, overnutrition is not yet a dominant trend in rural areas, however child stunting often remains high. The challenge is to continue reducing undernutrition without flipping to overnutrition.

Better nutrition and improved livelihoods are interlinked. Demand for more diverse and nutrient-dense diets can create new business opportunities for small-scale agrifood entrepreneurs (GLOPAN, 2020). Producing nutrient-dense foods increases income per hectare and could lead to growing numbers of small enterprises capturing opportunities in processing, storing and retailing a wider variety of high-quality nutritious food products targeting various customer segments. But high-value perishables require quality, safety, traceability and reliable deliveries, which can create barriers for small-scale producers.

FIGURE 5 UNDERNUTRITION UP – OVERNUTRITION ALSO UP



Source: Food Security Portal (https://www.foodsecurityportal.org/node/62).

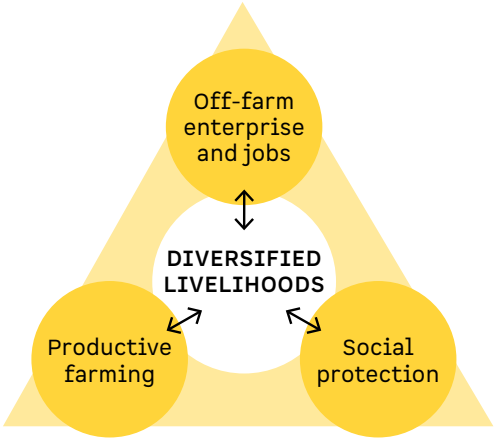
Environment: Creating value by feeding the world within planetary boundaries

The way food is currently produced contributes massively to environmental degradation and climate change (Springman et al., 2018; Willett et al., 2019; Dasgupta, 2021; Duku et al., 2021). Profound changes in the types of food produced, production practices and patterns of land use will be needed to feed the world within planetary boundaries. This shift presents substantial opportunities and risks for equitable rural livelihoods. Premiums for sustainably produced food or payments for ecosystem services and carbon sequestration can open up new economic opportunities. But the investments, technologies and management skills required may exclude less educated and poorer people. Another risk is that the costs of improving environmental performance will be pushed onto producers, rather than consumers paying the true environmental costs of their food, thus adding to the difficulty that farmers and rural communities experience in receiving an equitable share of value from the food economy.

Small-scale farmers are part of the solution in reducing the environmental footprint of food production. At least 30 per cent of global farmland is managed by small-scale farmers with less than 20 hectares, and in low- and middle-income countries the share is much higher.

Pathways to an inclusive agrifood economy for the next generation

Just as feeding the world well requires more diverse and nutritious diets, tackling rural poverty requires more diverse livelihoods. The pathways of productive farming, off-farm enterprise and jobs, and social protection must reinforce each other to provide equitable rural livelihoods. Farming will remain vital. But for many of the next generation of rural women and men, opportunities will come from branching out from primary production into the midstream of food processing, distribution and retail, as well as finance, equipment and other supporting services. To support their transition to new livelihood opportunities and to protect those stuck in poverty or hit by crisis, social protection will also be critical.



Pathways for an inclusive agrifood economy

Equitable rural livelihoods will require creating and capturing more value from the food system for the rural economy. Three trends suggest great potential for value creation from the food system in rural communities. First is substantially increasing the production of nutrient-dense and diverse foods, in particular fruits and vegetables, that have higher monetary value than staple crops (GLOPAN, 2020). Second is rapid urbanization in low- and middle-income countries, which increases access to markets and demand for high-value niche food products and services. Third is growing acceptance that society must pay for ecosystem and carbon sequestration services, creating potential income streams for those preserving and caring for land, water and biodiversity (Willet et al., 2017; Blended Finance, 2019; Lipper et al., 2021).

Even if a relatively small proportion of these new economic opportunities can be created and captured by rural communities, it can make a big difference in tackling poverty and inequality. The potential for new income opportunities is especially strong in the midstream of food systems.

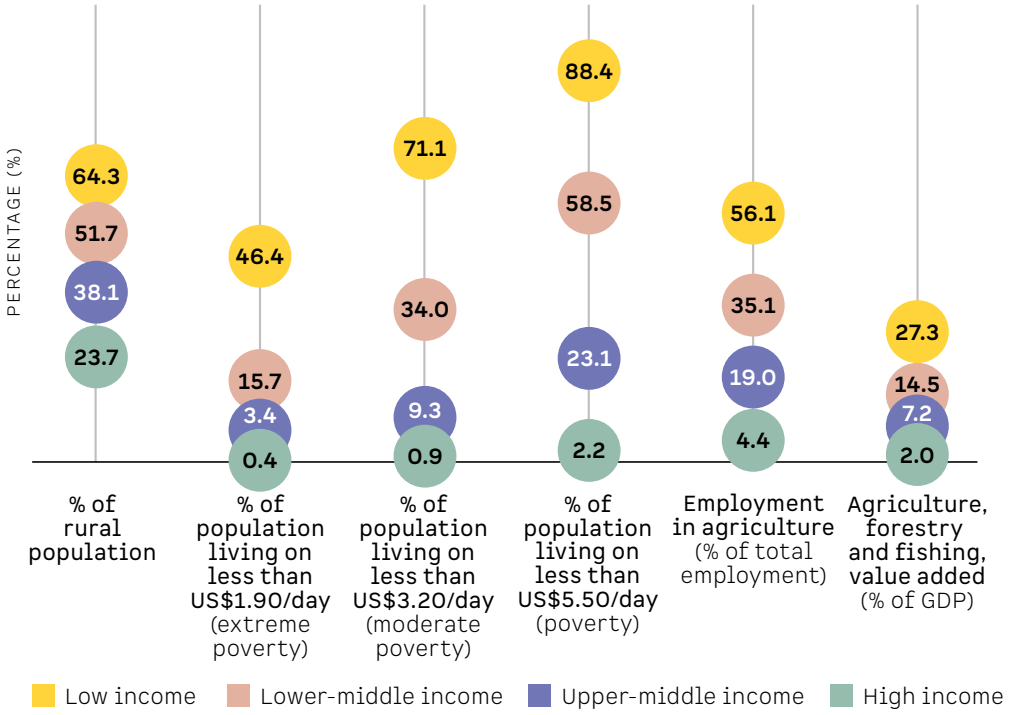
Entrepreneurship by small-scale producers and enterprises is key to an inclusive rural agrifood economy. Food systems are largely a private activity. They function, evolve and adapt through the entrepreneurial activities of small-scale producers, the vast network of microenterprises and SMEs, and the larger domestic and international firms.

The opportunities and constraints in creating equitable rural livelihoods are heavily influenced by the country context (IFAD, 2016). A country's income status, the role of agriculture in the economy, dominances of different food system types, employment in the agriculture and food sectors, and the financial and administrative capacity of governments all combine to shape pathways for diversified livelihoods (**TABLE 2** and **FIGURE 6**).

TABLE 2 COUNTRY CONTEXT SHAPES IMPLICATIONS FOR EQUITABLE RURAL LIVELIHOODS

COUNTRY TYPE	KEY FEATURES OF RURAL POVERTY AND LIVELIHOODS	DOMINANT FOOD SYSTEM TYPES	POLICY ENTRY POINTS/ OPPORTUNITIES FOR EQUITABLE RURAL LIVELIHOODS
Low-income	– High extreme poverty and malnutrition. – Economy dominated by agriculture, with slow development of other sectors. – Agriculture remains dominant employer. – High youth unemployment. – Limited opportunities for livelihood diversification. – Food insecurity may be high.	– Traditional systems still heavily present, but with diversifying systems emerging, driven by urbanization. – Restricted urban wealth not yet leading to substantial increases in high-value food demands. – Limited penetration of supermarkets, mostly catering to elite urban consumers.	– Agriculture remains critical to overall economy and rural development. – Constrained capacity of state to invest in rural development, including capacity development, infrastructure, technology and social protection.
Lower-middle-income	– Extreme poverty is being significantly reduced but substantial moderate poverty and rural inequality continue. – Rapid urbanization and increasing urban wealth, driving diversified livelihood options. – Growing opportunities for livelihood diversification. – Food insecurity significantly reduced, but undernutrition still present, combined with micronutrient deficiency.	– Rapid shift to diversifying food system, while traditional systems still common in rural areas. – Modern systems expanding and present in some rural areas. – Urban wealth has significant impact on types of food demand.	– Diversifying economy makes agriculture less important for GDP, but levels of employment still high in agriculture and food sectors. – Opportunities to diversify in the peri-urban space. – Increased but still constrained capacity of state to invest in rural development, particularly in countries with large poor rural populations. – Increased and easier access to agricultural markets.
Upper-middle-income	– Extreme poverty and hunger rapidly declining or largely non-existent, but rural inequality still significant. – Some marginal groups and areas not benefiting from wider economic development. – Significant opportunities for livelihood diversification. – Limited food insecurity, but increasing overnutrition and obesity.	– Diversified food system advances rapidly and coexists with increased prevalence of consolidated food systems. – Pockets of traditional systems in rural areas.	– Increasingly diversified economy with agriculture dropping in GDP and much lower agricultural employment. – Countries have significant resources to support rural development. Food imports from other countries may become significant.
High-income (Organisation for Economic Co-operation and Development)	– Some rural inequality still present. – Obesity and poor nutritional quality diets become major issues.	– Transformed food systems completely dominate. – Niche traditional/diversifying systems are attractive to some consumers and localized markets.	– Imports from low- and middle-income countries provide development opportunities. – Subsidies and tariffs have significant effects on the food economy in low- and middle-income countries. – Official development assistance contributions are important for food system development.
Fragile states and areas of conflict	– High extreme poverty, malnutrition, food insecurity and vulnerability. – Economy generally dominated by agriculture. – Limited capacity of state to support development.	– Traditional food systems remain important, combined with diversifying systems depending on country and type of fragility. – Humanitarian and food aid can have significant implications for food systems.	– Humanitarian aid is needed, and social protection programmes are crucial.

FIGURE 6 FOOD SYSTEMS VARY SUBSTANTIALLY BY COUNTRY INCOME, SHAPING THE OPPORTUNITIES AND CONSTRAINTS FOR DIVERSIFIED RURAL LIVELIHOODS

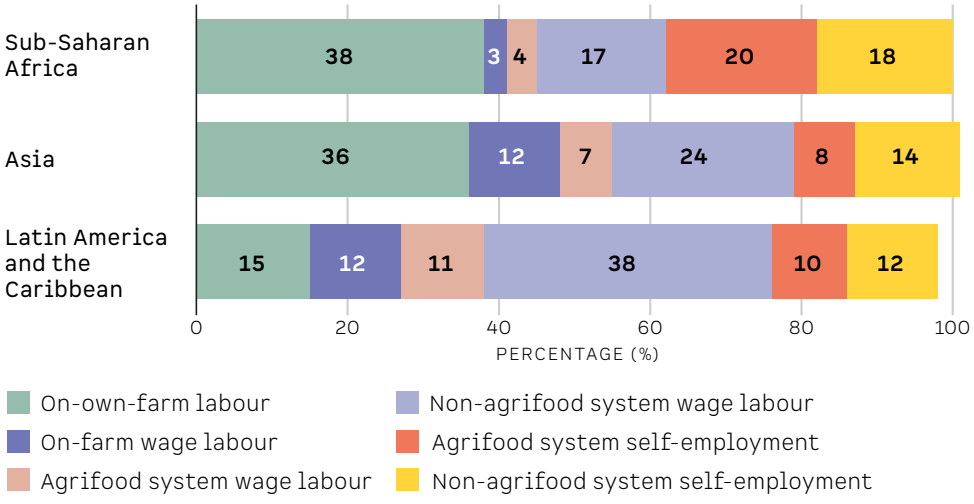


Note: Covers 152 countries with 7.3 billion people.
Source: World Bank, 2020b, and PovcalNet (http://iresearch.worldbank.org/PovcalNet/povDuplicateWB.aspx).

Diversified rural livelihoods

Rural people's livelihoods have diversified rapidly in recent decades. While most rural households still farm, many now combine farming with other sources of income to meet their needs. This diversification includes labouring on other farms, operating a wide variety of SMEs in the agrifood sector or wider economy, salaried employment and remittances from family members who have migrated to urban areas or abroad. Poorer households may also benefit from social protection. Many small-scale farmers are actually rural householders who also farm alongside their other non-farm income earning activities. The most marginalized – including female-headed households, youth, and indigenous peoples – are often landless and depend entirely on non-farm income. A study based on 13 low- and middle-income countries across different regions (Dolislager et al., 2019 and 2020) shows that farming accounts for no more than half of people's labour (**FIGURE 7**). It also shows that, while 70-80 per cent of rural Africans engage in farming in some way, this accounts for only 41 per cent of their working time. Despite this diversification, with farming complemented by off-farm activities, small-scale agriculture remains a cornerstone of rural livelihoods. Large household surveys across multiple countries also show substantial income diversification and the continued importance of agriculture (see the data annex).

FIGURE 7 ESTIMATED TIME ALLOCATION BY LABOUR CATEGORY IN RURAL AREAS

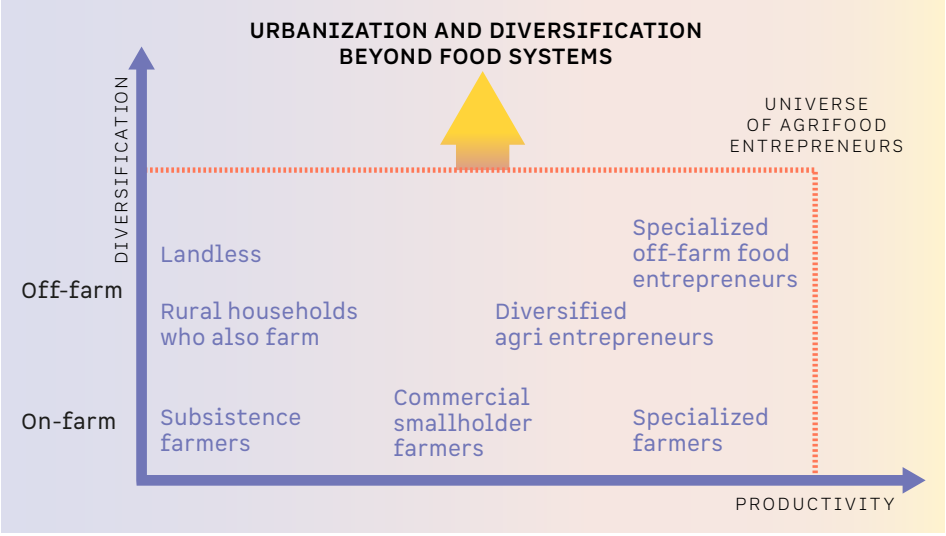


Note: Agrifood system employment is all food system activities other than on-farm production. The figures are population-weighted estimates from household surveys in 13 countries: Bangladesh, Cambodia, Ethiopia, Indonesia, Malawi, Mexico, Nepal, Nicaragua, Niger, Nigeria, Peru, Tanzania and Uganda.
Source: Authors' elaboration based on Dolislager et al., 2019, 2020.

A better understanding of patterns and types of livelihood diversification can guide policies aimed at improving rural well-being. Rural people can diversify into different types of jobs and enterprises, and they can specialize as farmers, as rural entrepreneurs or in full-time employment (**FIGURE 8**). A growing number of diversified agroentrepreneurs combine on- and off-farm enterprise opportunities in processing, packaging, distribution and even direct marketing to consumers. Realizing synergies between on- and off-farm livelihood opportunities is a key feature of inclusive food system transformation. It calls for new, broader and more integrated approaches to rural development (FAO, 2017; IFPRI, 2020).

Diversified livelihoods help, but they do not guarantee a living income. Off-farm labouring on other farms or in the agrifood midstream often commands very low wages. With the informal sector dominant, poor labour conditions and exploitation are common. The profits from microenterprises are often small, and women and men operators may be exploited by larger enterprises that have more market power. Households often diversify simply to survive and may be working long hours in different jobs and enterprises and still not meeting all their basic needs. Much needs to be done to ensure that those working in the off-farm agrifood sector get a fair deal.

FIGURE 8 PATTERNS OF LIVELIHOOD DIVERSIFICATION AND INTENSIFICATION



Household diversity and livelihood options intersect. Rural households have vastly different access to financial, physical, social, human and natural capital. They also vary greatly in gender dynamics, proportion of household members of different ages and gender, and ethnic and religious background (Doss, 2018). Households live in varied contexts that provide more or fewer livelihood opportunities depending on distance from markets and urban centres, access to infrastructure and services, and the productive potential of land and water resources. Increasingly, the extreme rural poor live in fragile states or conflict-affected areas where government services are negligible and the rule of law is weak. This diversity in contexts dramatically determines their livelihood options and their capacity to take up the opportunities that do exist.

For an increasing number of households, remittances from family members who have moved to urban or even overseas employment enable them to finance new enterprises. Even when households are earning most or all of their income off the farm, it is common for them to maintain ownership of land for security. Sometimes they will rent their land to those who need more land to become commercially viable. In some areas, this is leading to rapidly growing formal and informal land rental markets.

Support mechanisms are needed for those transitioning from farming to other livelihood options. These include appropriate education and skills training, financial and business support for establishing successful enterprises, enabling more flexible use of land, and schemes to reduce the risk that entrepreneurship entails. Social protection and subsidy schemes, along with secure tenure arrangements for rural people, need to support a just transition and avoid locking people into a farming poverty trap.

Off-farm enterprise: Realizing the potential of the agrifood midstream

Equitable rural livelihoods of the future will depend heavily on the food system midstream to provide diversified employment and enterprise options, to better connect farmers to input and output markets, and to add value to farm produce. Refocused rural development strategies and policies will be required to optimize this potential (Swinnen and Kuijper, 2020).

The midstream of the agrifood sector, dominated by SMEs, has grown rapidly. The last several decades have seen a quiet revolution in the agricultural and food markets of low- and middle-income countries, with a rapid growth in value (Reardon, Liverpool-Tasie and Minten, 2020; Vos and Cattaneo, 2020). The volume and value of food products transported from rural to urban areas has increased in the order of 1,000 per cent. The emergence of a vast number of microenterprises and SMEs in the midstream has created many new employment opportunities.

Enabling and supporting SME entrepreneurship in the midstream is essential for creating inclusive opportunities. Farmers depend heavily on SMEs for their input and output markets (Reardon, Liverpool-Tasie and Minten, 2020). A study by Dolislager et al. (2020) shows that on average midstream employment accounts for 25 per cent of rural employment, compared with 29 per cent for own farming, and that the midstream is more important for women's employment than men's. Developing the entrepreneurial skills of rural people, particularly youth, can ensure equality of opportunity in the midstream sector.

To date, most of the midstream in low- and lower-middle-income countries is part of the informal economy. It has been highly successful in keeping urban centres supplied and creating much employment and economic activity. But fragmentation and poor quality standards mean that the full potential for creating and capturing value from food markets is not being realized. The spread of benefits across rural areas and households is also very uneven, with some benefiting tremendously and others hardly at all, or even being adversely affected.

Policymakers can support this transition in four ways. The first is through upgrading entire value chain processes to improve efficiency and profitability. Only then can greater value be created, waste be reduced, and food quality and safety demands be met. The second is through policies to embed responsible investment principles and practices related to labour conditions, gender equality, the environment and climate. The third is by maintaining opportunities for large numbers of smaller-scale entrepreneurs and enterprises, and avoiding the concentration of power and ownership that seeks efficiency through reduced labour while actually withdrawing profits from rural economies. The fourth is by stepping up skill-building and accessible finance and business support so that rural people can take up entrepreneurial opportunities.

As with the midstream employment and enterprise opportunities so vital for women, gender inequalities need to be seriously addressed. Despite the opportunities for women along food value chains, women face discrimination, inequality and insecurity (Rubin, Boonabaan and Manfre, 2019). Their time poverty due to gender norms on care hinders many from taking up economic empowerment opportunities. But there are many practical ways to make a difference: infrastructure (health, childcare, water) to reduce their time poverty, access to banking and digital services, support groups for saving and enterprise development, land tenure rights, appointments to decision-making bodies at all levels – and engagement in economic decisions in the household, ensuring physical security and appropriate amenities in markets, and providing girls' education. Good examples of these measures are being put into practice, often with inspirational results. But a vast challenge remains to dramatically scale up such work and see educational parity translated into wage equality.

Policies and investments must foster entrepreneurship, create supportive conditions and promote inclusive access to opportunities. Ongoing and rapid evolution of the midstream will continue apace for the foreseeable future, driven by market demands and technological developments. But to what degree will it support or diverge from the goals of a food system transformation for better nutrition, sustainability and equitable livelihoods? Realizing the midstream's potential will require substantial policy innovation and refocused development investments. Public investment for the rural sector needs to balance support for agriculture with support that optimizes the potential of the midstream to reduce poverty and inequality.

Productive farming: A just transition for small-scale agriculture

With about 525 million small-scale farms of less than 20 hectares (Lowder et al., 2019), 2-3 billion people, or about 60 per cent of the rural population, live in households that farm. A viable and productive small-scale farming sector with strong market connections is a critical foundation for more inclusive rural economic and livelihood development, as well as being the basis for a thriving midstream of food systems (AGRA, 2017; IFPRI, 2020).

Creating the conditions for small-scale farmers to commercialize is a critical policy priority. Small-scale farmers need better access to inputs, services, finance, markets and infrastructure (Meemken, 2020; Ogutu, Ochieng and Qaim, 2020). There is also a need to reduce transaction costs and increase productivity and profitability so that small-scale farmers can be competitive and take the risk of responding to new opportunities. Without such support, opportunities are more easily taken up by better endowed and larger-scale farmers (Jayne et al., 2019). However, policymakers must also be realistic about what proportion of small-scale farmers – given land sizes, types of farming and markets – can commercialize in ways that would give them a decent living from just farming. In many areas, this may be a minority of farmers.

Small-scale agriculture may produce as much as 70 per cent of the food consumed in a low- or middle-income country.[1] Many of the world's smallest farms are surprisingly productive (**TABLE 3** and **FIGURE 9**[2]). There are 374 million farms (70.4 per cent of all farms globally) of less than 1 hectare, and many are much smaller still. These farms operate less than 7 per cent of the world's farmland but contribute 15 per cent of the world's calories. However, for some farmers growing staple crops – or even traditional cash crops such as coffee and cocoa – on these small areas of land, with often poor market prices, it may be extremely difficult to make a living income from farming alone. Even so, the food that this larger group of very small-scale farmers produces is critical for their own food and nutrition security, and for localized markets.

TABLE 3 INDICATIVE CHARACTERISTICS OF FARM NUMBERS, AREA FARMED AND FOOD PRODUCTION RELATED TO FARM SIZE

	FARM SIZE DISTRIBUTION[a]					GLOBAL FOOD PRODUCTION TYPE BY WEIGHT (%)[b]									
SCALE	FARM SIZE (HA)	% FARMS	NO. FARMS (MILLION)	% FARMLAND[c]	% GLOBAL PRODUCTION (KCAL)[d]	CEREALS	VEGETABLES	FRUIT	SUGAR CROPS	ROOTS/TUBERS	OIL CROPS	PULSES	LIVESTOCK	AVERAGE	TYPE[e]
Large	>200	0.2	1	57.0	18	18	11	18	35	9	39	18	18	21	Corporate (10%)
	50-200	0.4	2	12.8	19	22	19	17	14	15	25	18	23	19	
Medium	20-50	0.7	4	4.6	4	8	9	10	9	8	6	8	10	9	
	5-20	4.3	23	8.8	14	31	33	34	30	38	19	37	31	32	Family (90%)
	2-5	10.4	55	6.1	14										
Small	1-2	13.8	73	4.0	16	21	28	21	13	30	11	19	18	20	
	<1	70.4	374	6.7	15										

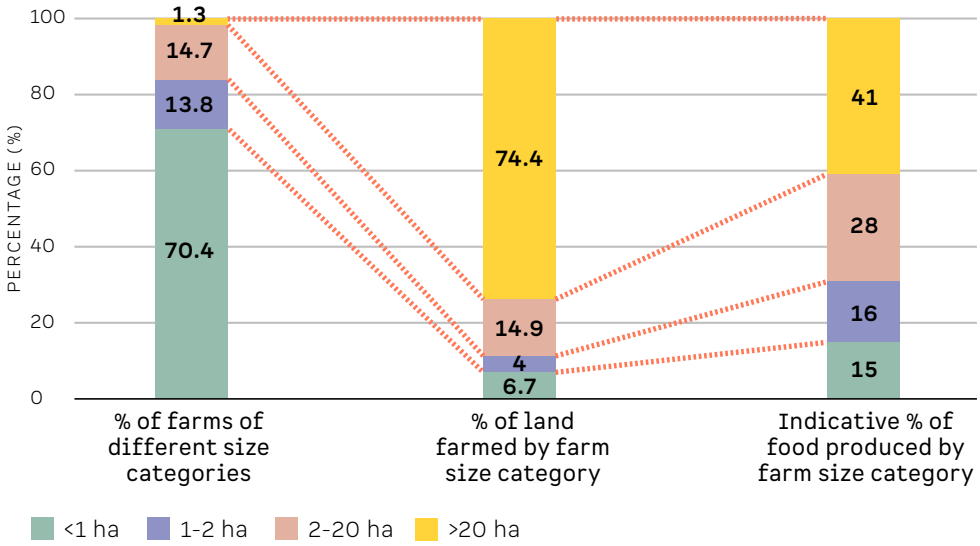
[a] Data from Lowder et al. (2019), table A2 – estimates based on 129 countries.
[b] Data from Herrero et al. (2017), values estimated from figure 1 – based on 161 countries.
[c] Data from Lowder et al. (2019) show that farms of < 2 ha use around 11% of farmland while Ricciardi et al. (2018) estimate this to be about 24%.
[d] Data from Ricciardi et al. (2018), values estimated from figure 2H – based on 55 countries.
[e] Data from Lowder et al. (2019).

Source: Woodhill et al. (2021), modified from Woodhill et al. (2020), based on data from Lowder et al. (2019), Ricciardi et al. (2018) and Herrero et al. (2017).

1 That small-scale farmers produce 70 per cent of the world's food (or of food consumed in low- and middle-income countries) is an often used statistic, but it appears to have no factual basis (Glover, 2014). Ricciardi et al. (2018) estimate that farmers with less than 2 hectares produce 30-34 per cent of global food. If production from 2-20 hectares farms is included, and the focus is on low- and middle-income countries, it is plausible that small-scale farmers may produce 50-70 per cent of food consumed in these countries.

2 Data presented in table 3 and figure 9 are estimates from the cited sources, which use different estimation methods. Most countries lack recent and detailed data. Global averages hide significant national and regional variations.

FIGURE 9 INDICATIVE RELATIONSHIPS BETWEEN FARM SIZE CATEGORY, AREAS OF LAND FARMED AND FOOD PRODUCTION



Source: Lowder et al. (2019) and Ricciardi et al. (2018) compiled in table 3.

In areas of population growth, high population density and limited land resources, it is impossible to keep dividing land with each new generation and still assume that farming can offer a decent living. Difficult issues of land tenure and land consolidation will have to be tackled in ways that are just and equitable. Already, the top 10 per cent of rural populations across a sample of countries captures 60 per cent of the agricultural land value, while the bottom 50 per cent of rural populations captures only 3 per cent of the land value (Bauluz, Govind and Novokmet, 2020). At the same time, good practices in enabling youth to access land have been documented and it is important that approaches to rural development identify where the next generation of farmers is going to come from (IFAD, 2021).

In many areas and for the foreseeable future, a significant group of rural households will be "hanging on", still heavily dependent for their income and food security on what little land they do have (Dorward et al., 2009). However, large numbers of people gleaning a marginal existence from farming is neither just nor equitable. Nor should it be assumed that all small-scale farmers want to remain farmers or see farming as a future for their children.

A just transition for small-scale agriculture will require maximizing opportunities for commercialization, enabling productive farming as part of a mixed livelihood and providing support for those who transition out of agriculture.

Livelihood diversification and off-farm income change the incentives for farmers. If farming households have diverse incomes, what becomes important is not total farm income but the return on farm labour relative

to other income-earning activities and how farming fits within diversified livelihoods. Having a very small plot of land is not necessarily a problem if it complements other sources of income, provided it gives a worthwhile return on labour. However, less dependence on farm income, or receiving very marginal returns, can be a disincentive to adopt productivity-increasing measures. This can create a negative spiral of low returns and low interest in farming. Across many farmers, this affects a country's overall food production.

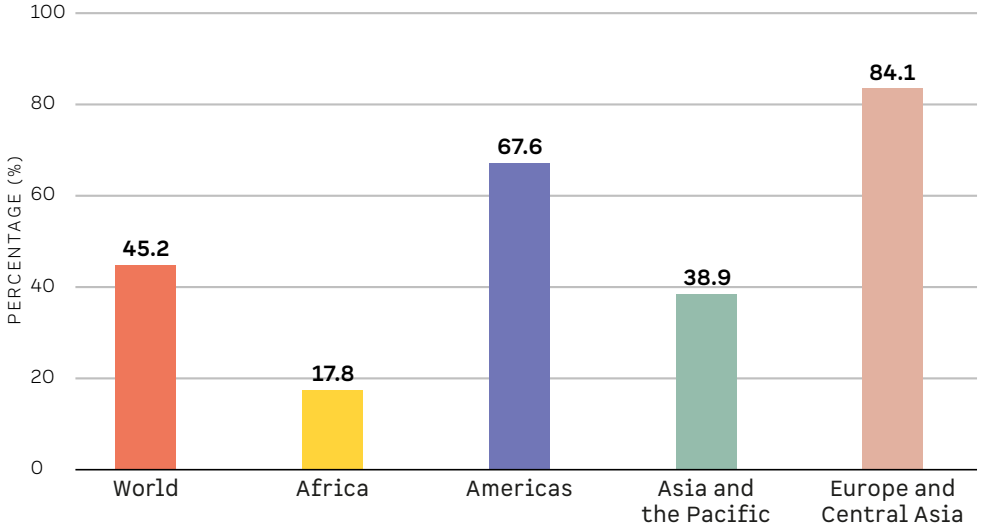
Yet farming can make a vital contribution to household livelihoods, even if not fully commercial (Frelat et al., 2016). When households have off-farm sources of income, it can become more economically rational for them to produce food for their own consumption, enabling them to reduce food expenditures, increase cash availability for other expenses and improve household nutrition. For very poor households that predominantly depend on producing their own food and on semi-commercial production for local markets, even small increases in farm productivity and income can keep families from going hungry and able to afford health and education costs.

For all these reasons, food system transformations need to take a broader look at the current and potential contribution of small-scale farming to rural people's overall livelihood. Support needs to be provided in a balanced way for commercialized small-scale agriculture, to improve semi-commercial farming and to enhance food production for self-consumption.

Social protection: Ensuring that people are not left behind

Even the best efforts to create more inclusive economic opportunities in the food system and wider rural economy will not lift everyone out of poverty. National governments and the international community must come to terms with the large numbers of rural people who are marginalized and vulnerable, and whose livelihoods will be hard to improve through wider economic progress alone. They include people living in conflict-affected areas and fragile states, or in marginal areas with poor resources and infrastructure. They also include some excluded and disadvantaged religious minorities, ethnic groups, indigenous peoples, and people living with disabilities. There is strong evidence that social protection is critical in lifting people out of extreme poverty (FAO, 2017; ILO, 2019), yet few people in low- and middle-income countries have access to adequate social protection (ILO, 2019) (**FIGURE 10**).

FIGURE 10 THE SMALL PROPORTION OF POPULATION COVERED BY AT LEAST ONE SOCIAL PROTECTION BENEFIT



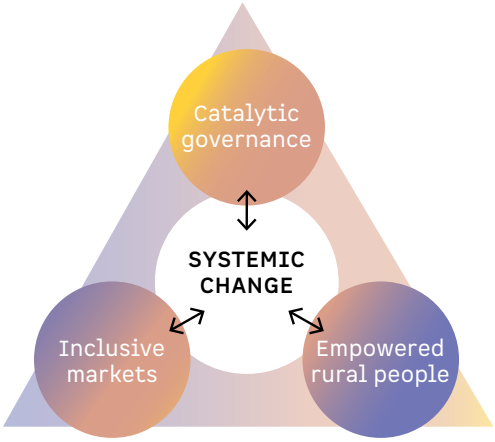
Source: ILO, 2017.

Innovative and productive forms of social protection that build resilience can be strengthened (FAO, 2017; IFPRI, 2020). Creating economic opportunities and viable livelihoods for those who are extremely marginalized due to geographic location or personal circumstance is undeniably difficult, but not impossible. Food is essential in all contexts, so food production and distribution always provide some opportunities for economic and market activity. More entrepreneurial approaches – such as the World Food Programme initiative on smallholder market support – can work for groups hitherto excluded from food-related economic activity. Such innovation has three benefits. First, linking public social protection investments to entrepreneurial and economic activity can improve the impact of limited public resources. Second, engaging in work through entrepreneurship offers people dignity, self-respect and independence. Third, such approaches can build household and community resilience.

Scaling up innovative and effective social protection schemes needs to be an integral part of the food system transformation agenda. Comprehensive approaches to social protection can work to protect those in poverty or crisis and prevent people from falling deeper into poverty. Approaches need to support the development of livelihood opportunities to ensure that poor and excluded groups have social and economic rights. Increased investments in social protection are clearly needed, but just as importantly, much more can be done to link social protection policies more effectively with policies to support diversified rural livelihoods (FAO, 2015).

Foundations for change so rural people prosper

The well-being of rural women and men is inextricably connected with how the entire food system functions, from the local to the global level. In turn, the food system is driven by a wider set of demographic changes, political economic conditions and consumer choices. Rural poverty, hunger and inequality cannot be overcome without bringing about systemic change in these wider conditions. Three foundations for change need to align: food system governance, inclusive markets that incentivize desired food system outcomes and empowered rural people.



Aligning the foundations for change

The need for systemic change

The required changes are far-reaching. The global agenda for transforming food systems can help us to rethink pathways out of rural poverty and inequality.

Systemic change will be needed to reshape the deeper structural economic, political and cultural factors that inhibit the creation of equitable livelihoods for rural people and healthy and sustainable food systems. Transforming food systems will challenge established assumptions, mindsets, procedures, political and economic interests, and power relations. Deep policy reform and substantial investment will be needed. Such change can happen only with extraordinary collaboration, coordination and communication across sectors, and across government, business, civil society, rural people's organizations and the scientific community.

Opportunities for rapid progress abound. Much knowledge exists about what has worked, and why, from countries that have reduced poverty, hunger and malnutrition, including Brazil, China and Ethiopia. One economic driver is the growing demand for safe, nutritious, convenient and sustainably produced food. Over the last decade, frameworks for responsible investment have been developed, with many private firms far more conscious and proactive about social and environmental responsibilities. A tremendous amount has been learned about creating sustainable and equitable value chains and about market approaches to tackling poverty. The critical need for women's and girls' empowerment has been unambiguously established, with numerous initiatives showing progress. The widespread uptake of mobile phones in remote areas offers the prospect of putting information and banking services at the fingertips of all rural people. There is extensive collaboration between scientific institutions to work on the core challenges of food system change. The experience from a wide range of existing social protection mechanisms provides a foundation to build on.

Optimizing the potential of digital and frontier technologies can support system change. Technology offers much potential to transform food systems – opening up inclusive market opportunities, providing rural services and enabling climate-smart production (Deichmann, Goyal and Mishra, 2016; Torero, 2019; Ceccarelli et al., 2020). Rapid technological developments in Asia, East Africa and Latin America have started to level the playing field for small-scale entrepreneurs. Progress has been significant in digitally enabled rural financial services, for example. But progress is uneven across regions, due to gender inequalities. Women continue to have less access to digital technologies, hindered by gender norms, lack of digital literacy and financial inequalities. For instance, many East African countries are years ahead of West and Central African countries in mobile coverage and digital uptake. Inclusive public policies and investments will be essential to bring the full potential of the digital and technological revolution to bear on rural food systems and rural entrepreneurship in all areas.

Catalytic governance to mobilize engagement and drive change

Engaging a wide constituency and building momentum. Ultimately, a failure of food systems is a failure of governance. Power relations and vested interests have locked in today's institutional arrangements, policy priorities and incentive mechanisms (Leeuwis, Boogaard and Atta-Krah, 2021). National governments play a central role as drivers and implementers of change. However, action generally needs to be implemented at a local level by a broad range of actors. At the same time, what is possible for a national government is constrained by global markets and geopolitical considerations. To catalyse change, measures in the public and private sectors need to coalesce around a shared vision underpinned by societal understanding and political commitment for action, and the voices of poor and vulnerable rural people must be heard at the table (AGRA, 2018).

History has shown that space for rapid change is often opened up by a crisis that affects large numbers and makes the status quo untenable, be it financial collapse, natural disaster, conflict or an outbreak of disease. A possible silver lining of the current climate and COVID-19 crises is the strong impetus for change that they are triggering. But the narrative for food systems change must be framed by issues and goals that stakeholders recognize and care about and in language they can relate to. A key to building momentum for systemic change is to show progress, to start where there is a powerful need and a demonstrated demand for action.

A key to building momentum for systemic change is to start where there is a powerful need and a demonstrated demand for action.

Setting direction together with a systems mindset. Any journey requires knowledge of the destination and a road map for getting there. So it is with transforming food systems. Governments, businesses, science and civil society need to collaborate on setting directions and taking actions. Over the last two years, the Food Systems Dialogues initiative has brought together

leaders from government, business, civil society, producer organizations and science. Numerous national dialogues have built momentum that will be furthered by the United Nations Food Systems Summit. Transforming food systems requires various parts of the government to work together, including ministries of agriculture, health, environment, social welfare, trade and industry, and finance. This can happen through strong leadership from the top and through interministerial working groups to collectively address trade-offs and synergies.

Food systems are complex, adaptive systems. To intervene in them calls for forms of policymaking that are adaptive, consultative and rooted in the principles of how complex systems behave, rather than assuming hierarchical and linear modes of control. Since change is always difficult, it is imperative to start making changes where there is a powerful need and a demonstrated demand for change. A concept like food system transformation appeals to professionals, but is unlikely to drive organizations and people to change the way they behave. The change narrative must be framed by issues and goals that resonate with stakeholders, and that can provide a basis for brokering synergies and trade-offs between the interests of different groups. People are always apprehensive about change, even though the consequences of maintaining the status quo may be far worse. When it involves something as sensitive as food and livelihoods, communication becomes a central element in any change process.

Tackling political economic barriers. Food system transformation needs to be driven by a strong, capable and committed public sector. But national governments are constrained by political economic factors including global markets, geopolitical considerations, domestic political influences, the interests of elites and the way citizens see the issues. Limited capacities within the public sector and corruption can combine to make investment and doing business in the agrifood sector difficult (World Bank, 2020a). Overcoming these interferences will have to start with easy wins and gradually make progress on the underlying structural constraints to change. What matters is identifying improvements that can actually be implemented, and implementing them consistently. Positive change can come through an almost unnoticed series of small changes as often as through large-scale and dramatic advances that are instantly noticeable.

Governments of low-income countries with an agricultural economy have a particularly challenging task, as they face difficult trade-offs to balance livelihood, nutrition and environmental outcomes with limited public resources – amid high levels of extreme and moderate poverty. The risk is stagnation in a low-level equilibrium. Lower-middle-income countries with a diversifying economy are going through rapid transformation in which stakeholder relationships are evolving. The challenge for their governments lies in maintaining and equally distributing the gains of ongoing transformation through inclusive policy mechanisms. Upper-middle-income countries have the scope to invest substantially in rural areas to largely eliminate extreme poverty and dramatically reduce rural inequality.

Using evidence to guide action and demonstrate progress. Good governance and effective policymaking need to be informed by evidence – with up-to-date, real-time data. Many countries lack basic information on what is happening for rural people, in relation to their livelihoods, poverty, nutrition, what is happening in the rural economy and what is happening to natural resources. Insufficiently granular and poorly disaggregated, the existing data give insufficient insight into the circumstances of different groups. And data and analysis tend to be focused on sectors – health, agriculture, the environment or the economy – making food system analysis difficult. Strengthening national data, statistical systems and integrated analysis and using the potential of big data and innovative digital technologies requires international collaboration and support. The 50 x 2030 initiative to close the agricultural data gap is an example of a multipartner programme that seeks to build strong national agricultural data systems so that policymakers can make sound decisions to drive their country's economic growth and reduce poverty.

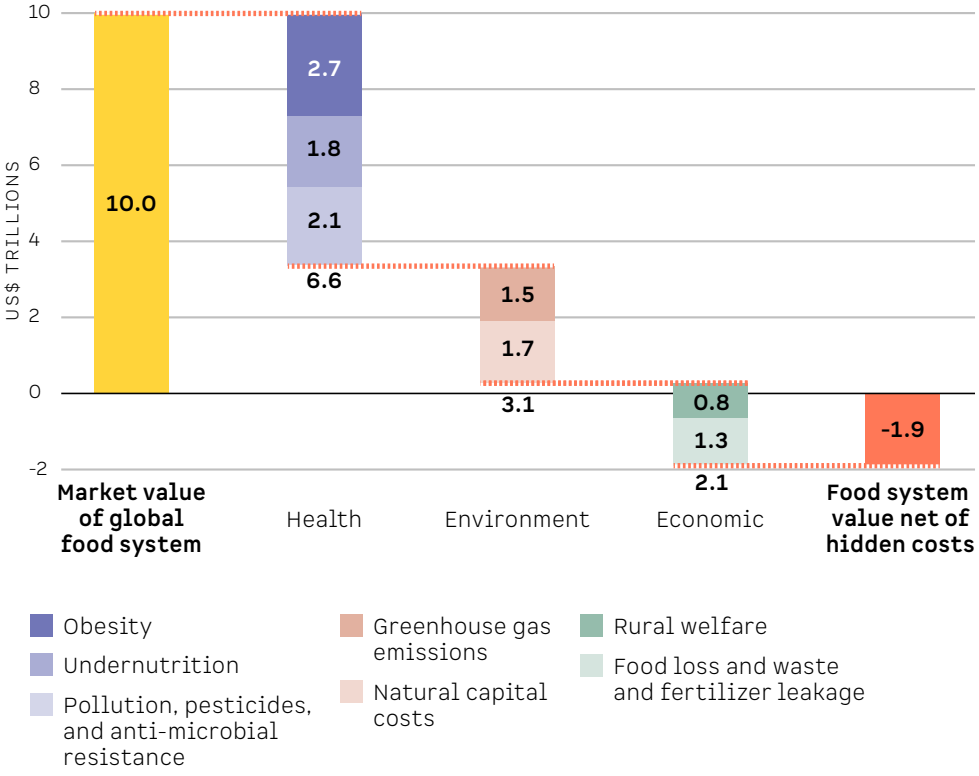
Inclusive markets rooted in local economies

To benefit rural people, food markets need to be accessible on fair terms. Incentives need to be in place that reward shared prosperity, healthy diets and environmental sustainability. A fundamental rethink of the incentive structure that drives food markets and trade should cut across global, national and local scales. A 2019 Food and Land Use Coalition (FOLU) report estimated that the "hidden" environmental, health and economic costs of food production and consumption actually exceed the total market value of the food system (FOLU, 2019; **FIGURE 11**). Rural entrepreneurship in the agrifood economy depends on more than the right incentives and trading conditions. It needs good infrastructure and services, an enabling business environment, and inclusive business and investment practices by larger firms (FAO, 2017; Bellmann, Lee and Hepburn, 2018; Mooney, 2018; López-Cálix, 2020).

Aligning incentives and trade for desired food system outcomes. Incentives can steer market actors towards investments and business practices that are in the collective interests of the entire food system (Clapp, 2017). Governments can use regulations, taxation, subsidies and price controls to ensure that market opportunities are not inequitably captured by elites and to correct market externalities (Searchinger, Waite and Ranganathan, 2019;). However, targeted market-based incentives have often led to perverse social, environmental and economic outcomes. The severity of challenges facing food systems calls for much more than tinkering at the edges. Large-scale policy reform coordinated across countries is needed, designed for a transition that is politically feasible, economically fair and socially just.

A key feature of the existing regime of food market incentives is agricultural subsidies, which aim to protect farmer incomes and stimulate agricultural production for domestic food security and export opportunities (OECD, 2020a). These subsidies distort markets, reduce overall economic efficiency, lead to overproduction and create perverse health and environmental outcomes.

FIGURE 11 THE HIDDEN COSTS IN THE FOOD SYSTEM ARE ESTIMATED TO EXCEED ITS TOTAL MARKET VALUE, 2018 PRICES



Source: FOLU, 2019.

Subsidies by richer countries for specific commodities have put producers from lower-income countries at a significant competitive disadvantage in both domestic and international markets.

Recent decades have seen substantial reform of agricultural subsidies, particularly by the European Union, to make them less market-distorting. Yet governments still provide more than US$600 billion per year in agricultural subsidies – 60 times more than total official development assistance support to agriculture and rural development (OECD, 2020a). The subsidies disproportionately target products with high emission intensities, such as rice, milk and meat. In low- and middle-income countries, agricultural subsidies are often geared towards staple food production at the expense of more nutritious vegetables, fruits, beans, eggs and fish (FAO et al., 2020). Lower-income countries have to trade off using limited public resources for agricultural subsidies or for rural infrastructure, education and social protection.

Rural livelihoods are highly influenced by global and regional food trade regimes (Mary, 2019) and the associated framework of trade subsidies, tariffs and non-tariff barriers. While only 15 per cent of food is traded globally, the globalized food market influences prices, returns and competitiveness across

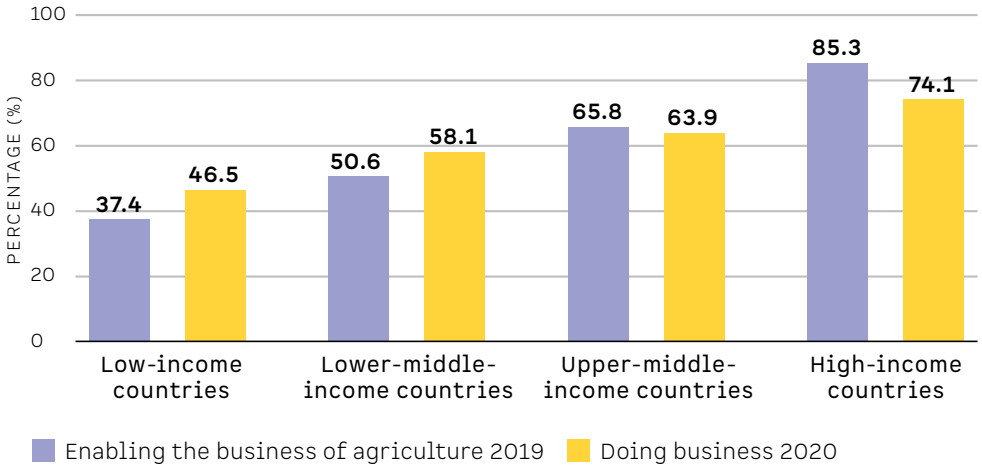
the board (European Commission, 2019). The agricultural trade landscape is in flux, with protectionism on the rise. Tariffs on agricultural products have been at the core of recent US-China trade disputes, which has helped countries in the Association of Southeast Asian Nations (ASEAN) and Latin American countries boost exports of some agricultural products. Regional trade agreements are also on the rise. East and South-East Asian countries are working to deepen regional economic integration through the China-ASEAN free trade agreement and the Regional Comprehensive Economic Partnership agreement between ASEAN and six other countries. The recently established African Continental Free Trade Area is expected to allow African countries to increase exports, better weather economic shocks and improve food security. These shifts in trade regimes will lead to a geographic reallocation of production and other activities along the value chain, and thus create winners and losers.

Improvements in nutrition and the environment might unintentionally set back rural livelihoods as large firms take a larger share of the overall processing sector. The World Trade Organization now recognizes that environmental and health requirements can impede trade and even be used as an excuse for protectionism. By hindering exports, they could cause unwarranted economic and social costs to others, particularly developing countries. SMEs are especially vulnerable. Similarly, SMEs and smallholders are likely to face growing challenges in meeting the food safety and environmental standards set by supermarkets and large processors (AGRA, 2019; Meemken, 2020).

Ensuring an enabling and inclusive business environment. An enabling business environment for on-farm and off-farm agrifood enterprises will help people set up and profitably run a viable small-scale food business. It entails a wide range of government regulations and procedures, and adherence to the rule of law: taxation, permits, financial regulations, cooperative law, quality and safety standards, import and export procedures, costs and time spent in adhering to government regulations, tackling corruption, and increasing the degree to which contracts are enforced. These factors have direct and indirect impacts on small-scale producers and entrepreneurs and other businesses with whom smaller-scale operators interact.

World Bank scores for ease of doing business and ease of doing agribusiness show that it is more difficult to do business in low- and middle-income countries (**FIGURE 12**). Business regulations and standards related to food quality and safety, environmental impacts and labour conditions need to be upgraded to add value and meet changing consumer demands – in ways that do not limit opportunities in the informal economy or for smaller-scale operators. Improved regulations and conditions for rural labour, on and off the farm, will be needed to improve incomes. However, such changes need to be managed carefully to avoid excluding people from employment, for example by employees shifting away from labour-intensive and towards capital-intensive production systems.

FIGURE 12 DOING BUSINESS IS MORE DIFFICULT IN LOW- AND MIDDLE-INCOME COUNTRIES



Source: World Bank, 2019, 2020a and 2020c.

Putting in place rural infrastructure and services. Inadequate rural infrastructure leaves communities isolated, holds back food value chain development, contributes to post-harvest food losses, and is associated with poverty and poor nutrition. Adequate rural infrastructure – including good-quality rural and feeder roads, reliable electricity, marketing and storage facilities, and digital networks – is essential for pro-poor growth and better rural livelihoods. Investments also need to be made in human capacity, with rural people supported to take up new opportunities in, for example, agricultural advisory, financial, business development, health and education services. Investments in infrastructure will create a positive cycle of economic development. The pay-off is often longer-term and so does not deal with the short-term food security and poverty issues that have a highly political influence over government expenditures. International financial institutions can help by providing loans and guarantees with long tenures that can be blended with private financing.

Strengthening private-sector partnerships for inclusive business operations. Private investment helps drive a country's overall agrifood sector development. Countries with agricultural and diversifying economies, with high levels of employment in the agriculture and food sectors, need to balance the interests and synergies of larger and smaller enterprises in the agrifood sector through policies that support the competitiveness of the SME sector. Larger-scale domestic and multinational agrifood firms play a critical role in the food system, including as retailers, seed and agrochemical suppliers, processors and financiers. While SMEs dominate the midstream of domestic food processing and distribution in countries with agricultural and diversifying economies, larger firms still have a significant and influential role. As economies transform, considerable concentration occurs in food value chains. Inclusive agrifood markets require a synergistic and complementary

interface between larger firms and smaller enterprises and entrepreneurs. Agricultural inputs are largely dependent on larger firms, which often depend highly on small-scale producers and intermediaries for their supply base.

Empowering and equipping rural women and men

Even if catalytic governance and inclusive markets rooted in local economies are in place, some rural people will still be unable to benefit from potential opportunities. For many, a lack of agency, assets and skills creates too much of a barrier. To ensure that vulnerable and marginalized rural people are not left behind, focused public investments and programmes should create the stepping stones from economic exclusion to economic inclusion.

Targeting rural poverty reduction. Governments in low-income countries with largely agricultural economies need to support almost 50 per cent of their populations living in extreme poverty (Bharali et al., 2020; Laborde, Parent and Smaller, 2020). They can do this only with a substantial amount of overseas development aid and by creating conditions for wider economic development. Governments in middle- and upper-middle-income countries must combine targeted support to the few extreme poor (5-7 per cent of the population on average) with broad-based economic development in rural areas to ensure people living in moderate poverty can also improve their livelihoods and are not left behind.

Using digital opportunities to increase voice and agency. Building the agency of rural people in food systems requires access to knowledge and financial services, as well greater bargaining power for small-scale producers and agrifood entrepreneurs, facilitated through the digital revolution. Today's rural youth in low- and middle-income countries are the first generation whose entire working lives will be permeated by digital technology. By reducing the cost of information and massively increasing its availability, technology has dramatically sped up the pace and altered the nature of change. The COVID-19 pandemic has further accelerated the digital revolution, but it has also shown that marginalized socio-economic groups are also those with less access to digital services. Such services often are not aligned with their needs, creating further marginalization, so focused government policies and programmes are needed to avoid a digital divide between wealthier and poorer people.

Creating services to support small-scale rural entrepreneurship. Broadening donor support for a food systems approach can help the next generation of small agrifood entrepreneurs by providing them with the necessary education and access to financial and advisory services. To date, governments and international agencies have often focused rural development investments on supporting small-scale agriculture and on increasing agricultural productivity. In a rapidly transforming global food system, it will be critical to increase support for livelihoods in off-farm agrifood businesses. Not doing so risks locking the next generation into a context of farming in which it will be virtually impossible to escape poverty.

Business support networks, which complement farmers' organizations, can further participation of small-scale entrepreneurs, especially women, and influence policymaking. Uniting small enterprises active in food processing, distribution and retail in agrifood organizations can increase their bargaining power and reduce high transaction costs that prevent larger players from doing business with them. Such networks can also provide economic services to their members, including access to finance, market information, skills development and transportation to larger markets.

Reconfiguring and expanding rural financial services is essential for the transition to inclusive food systems. Governments and private entities can establish and finance support structures that enable rural women and men to develop the business, financial and technical skills to identify opportunities, undertake business planning and manage business operations. The near universal presence of mobile phones and digital services in rural areas provides new entry points for rural people to access financial services. The management and governance capacity of established financial institutions can be linked with the local know-how and agility of informal and semi-formal financial service providers, such as savings and credit cooperatives, village banks or informal savings groups. Such partnerships can help break the barriers to growth that innovative rural finance initiatives have faced in recent years. New forms of agrifood enterprise require new financial instruments, including climate insurance and blended finance.

Providing knowledge and information services through digitally enabled tools or services has been shown to be more cost-effective than many traditional extension organizations and programmes. In-person extension services with on-the-field approaches, such as demonstration plots, group training and farm visits, are expensive, severely restricting access and reach. Digital knowledge services to empower farmers and off-farm entrepreneurs include advisory and information services, market linkages, supply chain management, financial services and macroagricultural intelligence. Digitization can better connect buyers, sellers and producers, including through digital marketplaces and end-to-end supply chain management solutions.

Investing in a new generation of agrifood education, skills and capabilities. The next generation of rural women and men need capacities and skills very different from those of their parents. Old-style vocational programmes will not prepare them for new economic opportunities. The pace of change in education will need to be in step with the pace and nature of transformation in a country's food system. The nature of work is changing fast and creating demand for new sets of skills related to food transport and processing, support services, and nutrition and environmental services.

The next generation of rural women and men need capacities and skills very different from those of their parents.

The new digital era puts new demands on rural people. Evidence on soft skills is emerging in both wage employment and self-employment and in the establishment of microenterprises in rural and other areas in developing

countries. Educational institutions have to teach not only basic technical digital skills but also advanced cognitive and non-cognitive skills to enable those they teach to become successful agrifood entrepreneurs.

Conclusion

Past rural development policies and investments have focused heavily on improving agricultural productivity and less so on opportunities across the entire food system. The global food systems agenda provides an opportunity to reframe improving rural people's well-being. It also enables linking livelihoods to the environment and nutrition to create resilience.

The vision of this report is one of change driven by a new generation of rural agrifood entrepreneurs – young women and men who use their innovative energy, digital skills and voice to capitalize on opportunities to drive rural prosperity for all. Much of what needs to be done to improve food systems and the lives of rural women and men is well understood. The challenge lies in bringing about the required scale of systemic change. This requires political innovation to take decisions for the long term. Inclusive and forward-looking dialogue, while no panacea, is a starting point.

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PART A

Food consumption

Chapter 1 on food consumption patterns and preferences analyses the nutrition constraints of current food systems and identifies changes to induce a healthier food supply tailored to consumer demand for more nutrient-dense foods. To accomplish this, policymakers should focus the food policy agenda on tailoring public investment programmes and government procurement, combined with responsible private sector innovations and market incentives to diversify diets and make food choices heathier and more sustainable. They should use market-based incentives and innovation programmes to support poor people's food purchasing power and women's bargaining power – and enable them to make better-informed food choices through training, labelling, communication and digitalization. And they should promote the establishment of a supportive food environment that uses legal and regulatory regimes (with grades and standards), as well as fiscal measures, to support affordable food prices in favour of nutrient-dense foods.

Chapter 2 explores animal-sourced foods (ASF), their critical role in the nutrition and livelihoods of poor rural communities, and the health and environmental impacts when they are heavily consumed by all of society. Game-changing, yet realistic solutions are needed to drive the transition towards healthy and sustainable consumption patterns in a culturally appropriate manner. Mechanisms should be put in place that create incentives for markets and corporations to provide ASF for healthy and sustainable diets, based on national dietary guidelines. Awareness-raising should focus on both the pros and the cons of consuming ASF in various quantities.

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CHAPTER 1
Supporting healthier diets for poor people

Poor people don't just need food – they need nutritious food. Widespread challenges limit the consumption of nutrient-dense foods by poor people in both rural and urban areas. Closing the critical diet gaps is one of today's most urgent priorities.

How can food systems be transformed to make healthier diets more available, accessible and affordable to the world's poor? How can such transformations support diversified, desirable and durable consumer choices? And how can transformed food systems guarantee nutrition and health while promoting a safe, stable and inclusive food environment that is not only equitable but sustainable?

This chapter starts by analysing the nutrition constraints of current food system transitions for poor people. It then identifies the main changes needed to induce a healthier food supply and to tailor consumer demand towards more nutrient-dense foods – using both market-based incentives and public investments to steer food choices, all while respecting planetary boundaries. The chapter develops four key messages:

1. **In both rural and urban areas, poor people bear a triple burden of malnutrition – undernourishment, micronutrient deficiencies and overweight prevalence – because current food system transitions have not made nutritious diets sufficiently available, accessible or affordable to them.** Economic, demographic and policy trends are reinforcing this triple burden disproportionately on poor people, and the effects of the COVID-19 pandemic on food systems worldwide heighten these challenges.

2. **To reduce critical nutrition gaps, a food system transformation needs to have four dimensions: driving consumer choices towards more diversified diets, empowering women and other disadvantaged groups, strengthening rural-urban linkages and improving physical access to varied types of food markets and food outlets.** For poor people to consume more nutrient-dense foods, they must be able to make healthier choices – choices based on better information and greater access to affordably nutritious diets. Empowering poor people, including women in food systems, to earn better incomes and taking control over consumption can yield significant benefits in health and nutrition outcomes.

3. **Because food systems respond to consumer demand, demand-led incentives must be the main levers for food system transformation, and shaping these incentives must be a central focus of policymaking.** Key areas to emphasize are targeted social safety nets and cash transfers to poor people; support to women's empowerment and gender equality to level access to resources and widen choices; promotion of better food preparation practices; and behavioural change communication. Other incentives with potential benefits include food quality labelling and marketing, and promoting ICT-based market information systems and product imaging.
4. **Public regulation and investments are imperative to support a more inclusive food environment.** To elicit balanced and diverse food demand, and nudge consumers towards healthier and more sustainable dietary choices, food-system-related laws and public investments must steer the social practices and cultural norms of diverse categories of consumers. Specific actions can involve legislation and capacity-building; fiscal policy instruments such as tariffs, taxes and subsidies to modify food prices and influence consumer choice; food-based dietary guidelines; co-investment and institutional procurement; and behavioural nudging.

How must food supplies improve to close critical nutrition gaps, especially for poor people?

Food systems are under increasing pressure to deliver healthy diets to poor people. Inadequate diets are a major cause of malnutrition, morbidity and mortality worldwide. Despite some progress in reducing undernourishment (stunting and wasting), the "hidden hunger" of micronutrient deficiencies persists. And the prevalence of overweight, obesity and diet-related non-communicable diseases is rising globally – most rapidly in low-income countries (Development Initiatives, 2020). Many countries face a "triple burden" from multiple forms of malnutrition (Popkin, Corvalan and Grummer-Strawn, 2020). The resulting burdens exceed those attributed to many other global health challenges (GBD 2017 Diet Collaborators, 2019).

What makes a diet healthy? Generally, healthy diets are diversified and proportionally divided among various food groups. They include adequate amounts of fruits and vegetables, whole grains, legumes and nuts. They also provide sufficient intake of starchy staples and animal-sourced foods (ASF): preferably milk, eggs, poultry and fish. In contrast, today's food systems are traditionally based mainly on staple foods that are eaten routinely and that largely provide calories. Thus, while the world has more than 50,000 edible plants, just three of them – rice, maize and wheat – provide 60 per cent of food energy intake.

Healthy diets also avoid or limit the consumption of foods that pose a threat when eaten to excess. Such foods include free sugars (sugar-sweetened beverages), foods with certain amounts of total energy and certain types of fat (especially saturated and trans fats), salt (which, when consumed, should be iodized), red meat, processed meat and ultra-processed food (UPF) (Herforth et al., 2020; on processed and ultra-processed food, see CHAPTER 7). Part of the challenge today is that consumption of these foods is on the rise in low-income and middle-income countries undergoing a nutrition transition (**BOX 1.1**).

The COVID-19 pandemic has fast-tracked the need to transform food systems. Immediate challenges to stable food supply and demand have arisen as a result of border closures, local market lockdowns and income losses among own-account and migrant workers. Pandemic-mitigation measures have caused dramatic declines in domestic trade and self-employment, with devastating consequences for poverty and malnutrition (Béné et al., 2021). This shift from a health crisis to a global economic and local food crisis highlights the urgency of making the food system more broadly resilient to different sources of vulnerability – it must become more adaptive, responsive and future-proof.

Especially vulnerable to the risk of nutritionally inadequate diets are women, children and adolescents of poor households in rural and peri-urban areas. Inequalities in nutrition are related to differences in gender empowerment and strongly driven by socio-economic disparities determined by location, income, wealth, education and ethnicity. Further compounding these inequalities are conflict and other forms of fragility (Development Initiatives, 2020).

BOX 1.1 THE NUTRITION TRANSITION, CHANGING DIETS AND NEW DIETARY HEALTH RISKS

Diet changes result largely from trends elsewhere in the food system. Many countries are in a nutrition transition (Popkin, 1993) that consists of three processes:

1. An increase in incomes with a concomitant reduction in income share devoted to food purchases.
2. A shift in food preferences involving a shift towards more nutrient-dense, animal-based and processed products.
3. Increasing urbanization, so that more food is provided by modern retail outlets and out-of-home food services.

This transition generally drives a decline in undernutrition. Even so, as more food is consumed – especially ASF and UPF – new overweight and obesity risks appear. Critical nutrition gaps for particular socio-economic groups shift from underweight to micro-nutrition deficiencies and overweight. Dietary health risks change towards non-communicable diseases, which are far more expensive to treat.

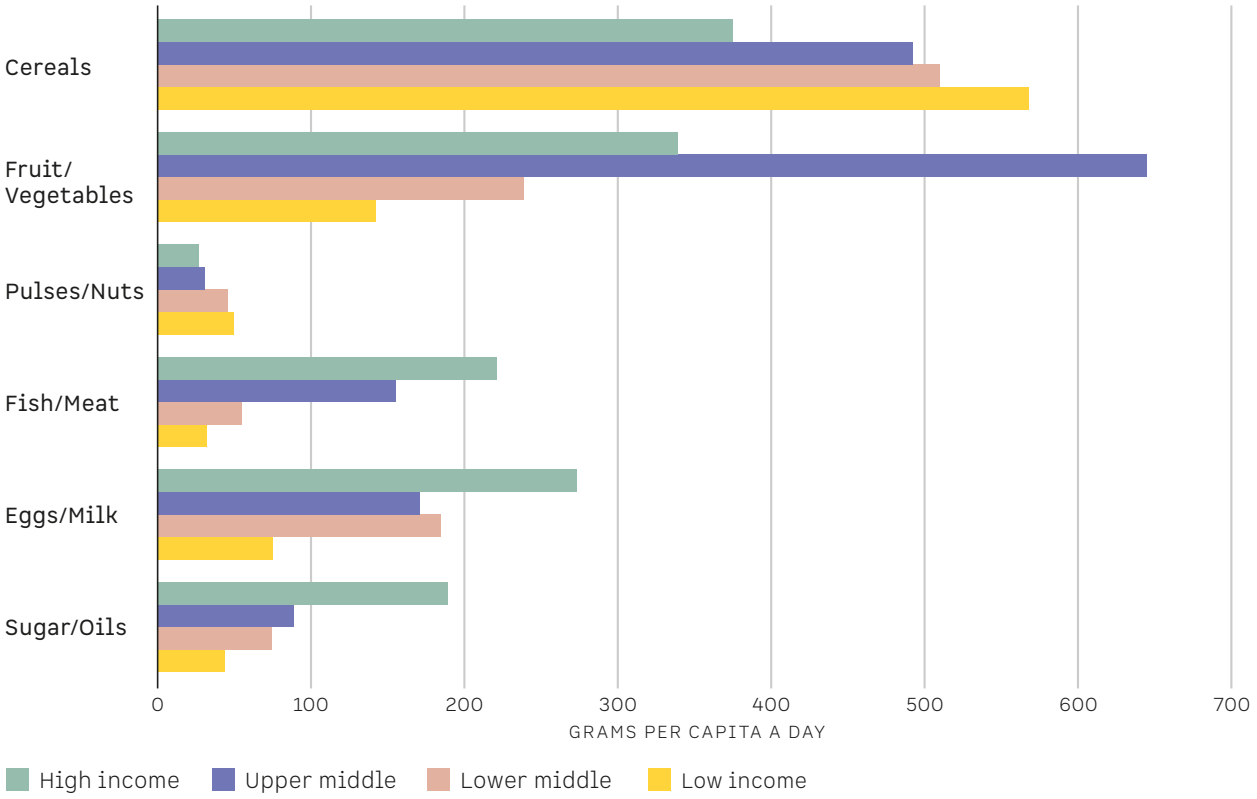
Source: Popkin, 1993.

Healthier diets must become more available and affordable

For many poor people, healthy diets are out of reach because of obstacles to both availability and affordability. A basic principle of healthy diets is diversity and proportionality among food groups. Countries with different income levels diverge in the availability of each food group (**FIGURE 1.1**). In low-income and lower-middle-income countries with more rural and traditional food systems, cereals and pulses predominate. Middle-income and high-income countries consume more fruits and vegetables. Upper-middle-income and high-income countries consume larger shares of fish, meat, sugar and oil.

Healthy diets are unaffordable for more than 3 billion people, most of them in Africa and Asia (FAO et al., 2020). Generally, the cost of a diet that meets food-based dietary guidelines is between US$3.27 and US$4.57 a day (Herforth et al., 2020). This is 60 per cent higher than the cost of meeting nutrient needs only – and almost five times the cost of meeting energy needs through basic starchy staples. Similarly, the EAT-Lancet reference diet is unaffordable for many people (FAO et al., 2020; Willett et al., 2019). For a basic plate of food (staple and legume stew), people would have to spend 9-50 per cent of their income on food in Asia, and 25-158 per cent in non-conflict-affected countries in Africa (WFP, 2017).

FIGURE 1.1 AVAILABLE QUANTITIES OF EDIBLE FOOD IN VARIOUS FOOD GROUPS, BY COUNTRY INCOME

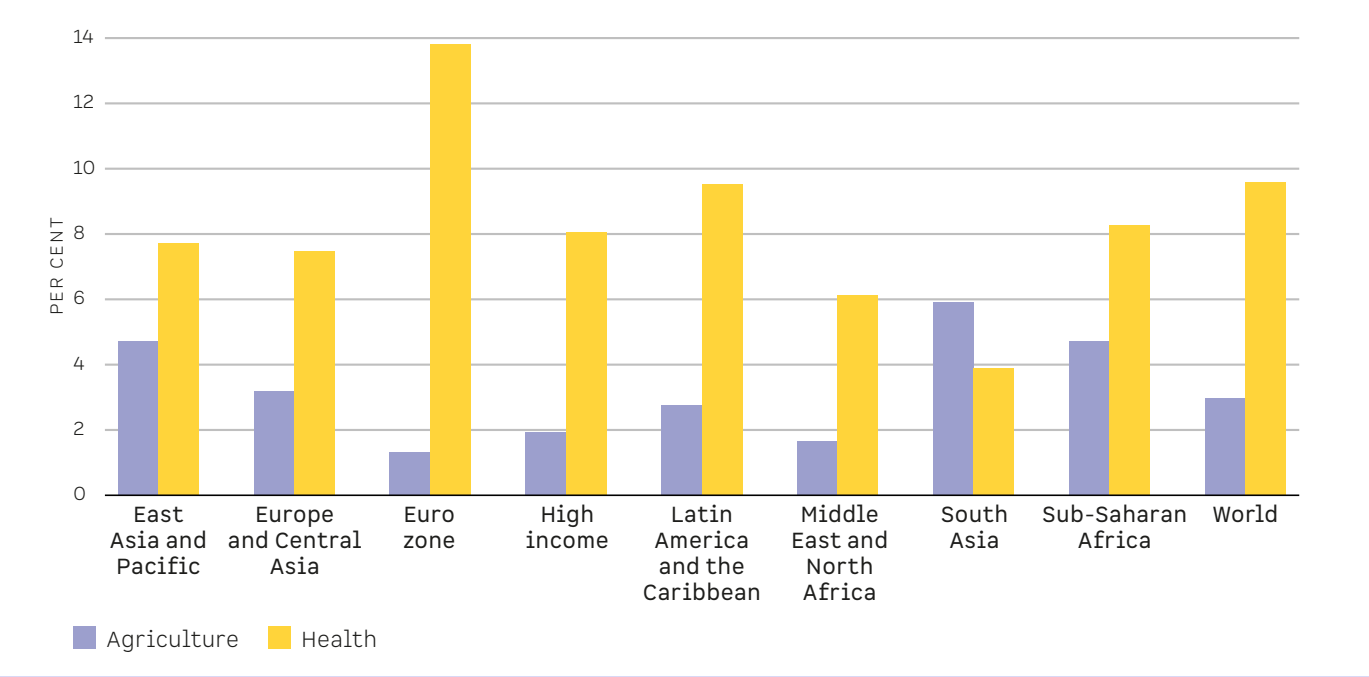


Source: Adapted from the *State of Food Security and Nutrition in the World 2020: Transforming Food Systems for Affordable Healthy Diets*. (FAO et al., 2020).

Healthy diets are generally more expensive than today's less healthy diets (Gurmu et al., 2019; Mendoza et al., 2017; Nykänen et al., 2018; Pondor et al., 2017; Verly et al., 2020). The high cost of a healthier diet mainly reflects high prices for nutrient-rich non-staples (fruits, vegetables, pulses) that drive poor people towards cheaper, starch-heavy diets. Healthier diets can be more affordable and more environmentally sustainable if people moderate their intake of ASF (Headey and Alderman, 2019). And the higher price of better diets can be offset, or even recovered many times over, by savings in health costs (**BOX 1.2**).

BOX 1.2 IMPROVING DIETS TO REDUCE HEALTH COSTS

Health costs represent 25-30 per cent of GDP in low- and middle-income countries. Except in South Asia, public expenditures for health care are two to four times higher than budgets for agriculture and rural development. Direct out-of-pocket payments by individuals to health-care providers represent 40-45 per cent of total health costs. Total health spending is growing faster than GDP, increasing more rapidly in low- and middle-income countries (close to 6 per cent on average). External funding represents less than 1 per cent of global health expenditures. Investing in healthier diets can generate a large pay-off in reducing health costs for individuals – and for society at large: for every US$1 invested in improved nutrition, US$16 can be saved in health costs.



Source: IFPRI, 2019, Statistics on Public Expenditures for Economic Development (SPEED) database.

Foodborne diseases must be prevented

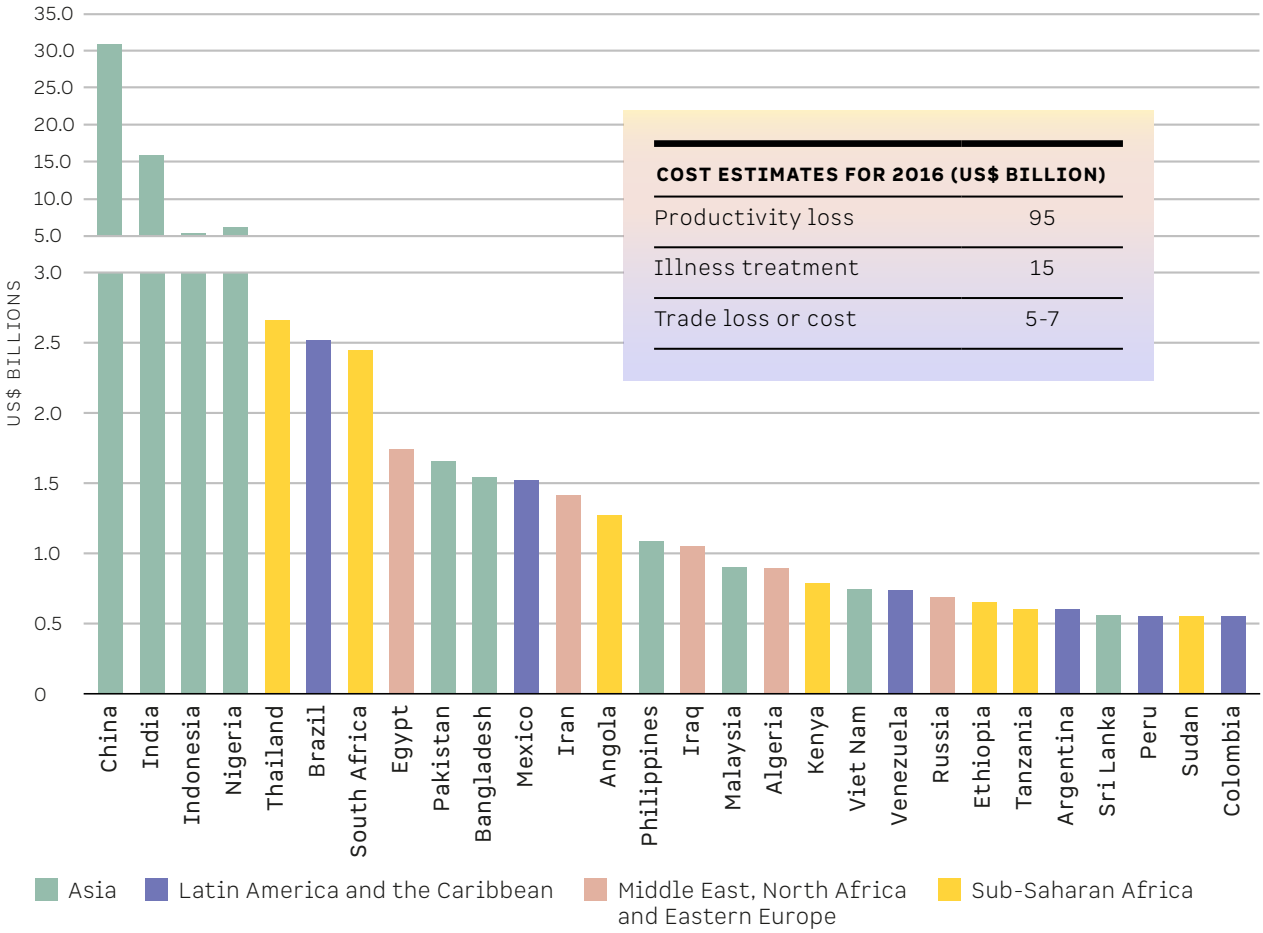
Foodborne diseases (FBDs) caused by biological food contamination are the largest threat to poor people´s nutrition, food safety and health. Diets should contain minimal (zero) levels of pathogens, toxins and other agents that can cause diarrhoeal or other FBD (FAO and WHO, 2019). Food safety has direct implications for women's health and child nutrition. Pregnant and lactating women are especially vulnerable to FBDs because of their modulated immune system. Some FBDs cause foetal abnormalities, abortion and stillbirths, and chemical hazards can be transmitted to the newborn through breast milk (Grace, 2021). Children under 5 years of age and people in low- and middle-income countries are disproportionately affected by FBDs: they make up 9 per cent of the world population, suffer from 38 per cent of all foodborne illnesses, succumb to 30 per cent of foodborne deaths and bear 40 per cent of global foodborne disability-adjusted life-years (DALYs).[3] The incidence of FBDs is highest in Africa and South-East Asia, along with the highest death rates and DALY loss (**FIGURE 1.2**). In developed countries, most FBDs result from consuming animal-sourced products and contaminated produce (fresh fruits and vegetables). The World Bank estimates that the economic cost of FBDs in low- and middle-income countries will rise to more than US$100 billion a year (Jaffee et al., 2019).

Aflatoxins that attack maize, groundnuts and other staple crops produced in Africa are infecting food markets. They can cause liver cancer, are associated with stunting in children and are correlated with immunosuppression. In high doses, they can cause acute and fatal poisoning. Several practices can reduce aflatoxin contamination using biocontrol agents ("aflasafe"). These products are developed by international research agencies and need private investment to guarantee upscaling. Concerns are also increasing about health risks from chemical residues in food. A recent World Health Organization report found that 31 FBD agents (biological and chemical hazards) accounted for around 420,000 deaths worldwide, imposing a burden of around 33 million DALYs each year (Havelaar et al., 2015).

Food safety can be reinforced with better access to clean drinking water and sanitation, health-care services (especially prenatal and postnatal care) and integrated environmental conservation programmes.

3 Disability adjusted life years (DALYs) are the sum of years of potential life lost due to premature mortality and the years of productive life lost due to disability.

FIGURE 1.2 ECONOMIC COST OF FOODBORNE DISEASE IN LOW- AND MIDDLE-INCOME COUNTRIES



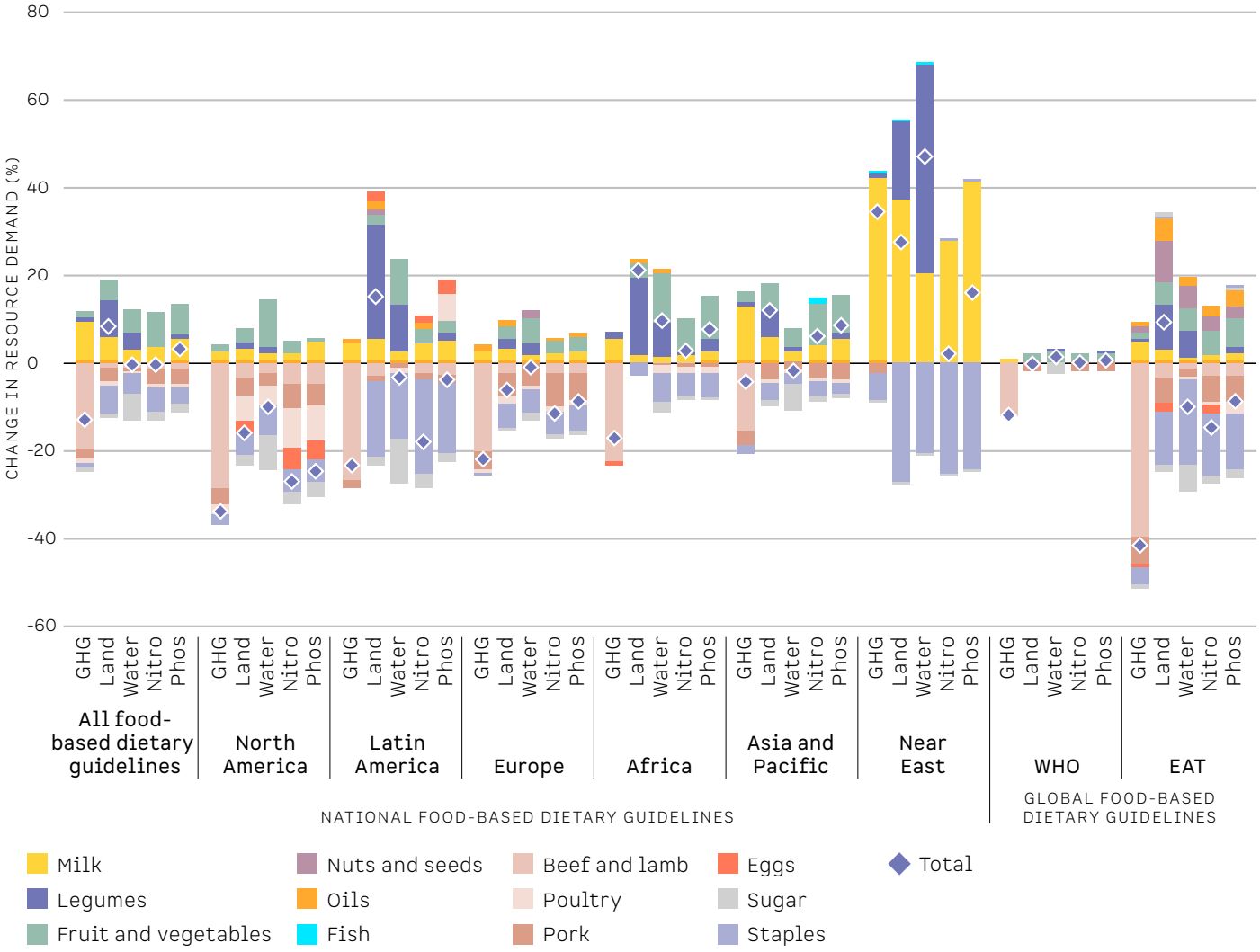
COST ESTIMATES FOR 2016 (US$ BILLION)	
Productivity loss	95
Illness treatment	15
Trade loss or cost	5-7

Note: Productivity loss = Foodborne Disease DALYS x Per Capita GNI.
Source: Grace, 2021, based on World Health Organization and World Development Indicators data and Jaffee et al., 2019.

The food systems of tomorrow must be sustainable and equitable

Not all healthy diets are sustainable, and not all sustainable diets are healthy – yet evidence suggests that synergies can be generated (Béné et al., 2019). Commonly used indicators to evaluate the environmental impact of diets or individual food items are greenhouse gas (GHG) emissions, water use, land use, acidification and eutrophication. Healthier diets (following food-based dietary guidelines) would add to GHG emissions from increased intake of animal-based foods (**FIGURE 1.3**). Optimal dietary patterns that align sustainability and health goals vary considerably between countries depending on how and where foods are produced (GLOPAN, 2020; Kim et al., 2020).

FIGURE 1.3 ENVIRONMENTAL EXTERNALITIES OF DIFFERENT DIETS



Note: Figures are changes in environmental resource demand for adopting national or global food-based dietary guidelines by food group and environmental domain.

Source: Springmann et al., 2020; World Health Organization, EAT-Lancet Commission on Healthy Diets from Sustainable Food Systems (EAT).

In general, sufficient evidence that sustainable diets can go hand in hand with healthy diets is emerging from studies that compare the environmental sustainability and healthiness of hypothetical diets (Kim et al., 2020; van Dooren et al., 2018), and those that evaluate the environmental impact of food-based guidelines or actual dietary intake (Behrens et al., 2017; van de Kamp et al., 2018). A recent modelling study, with data from 85 countries, concluded that diets based on national food-based dietary guidelines could be environmentally sustainable and also healthier (**BOX 1.3**) (Springmann et al., 2020).

BOX 1.3 MANAGING ERITREA'S FISHERIES

With a long coastal border on the Red Sea, Eritrea's fishing market has potential for sustainable growth in an environmentally friendly fashion. This would result in improved livelihoods for fishers and their families, as well as more nutrient-dense diets.

The Fisheries Resources Management Programme began operations in 2016, with both societal and environmental objectives. It aims to increase fish production and income generation for dietary improvements, thus bringing the nutrition and health benefits of fish to local diets, while also preventing overfishing and ensuring environmental integrity. Activities include developing and disseminating fishing equipment and investing in climate-smart products, such as solar fish driers, and improved access to water sources. Training ensures safe fishing operations. Planting mangroves provides more environmentally friendly habitats for fish.

Under the programme, 330 government-constructed reservoirs have increased inland fish production. In addition, intensive watershed management – coupled with the continued planting of mangroves to sequester greenhouse gases – is enhancing climate resilience. An estimated 17,500 rural households will benefit once the programme is concluded, including both inland and coastal populations in six regions. The project has set 30 per cent inclusion targets for both youth and women.

Source: IFAD project completion reports and impact assessments.

Equity in food systems can be improved only if structural imbalances in the access, availability and price of healthy diets are addressed, and opportunities for reducing nutrition inequities are recognized (Development Initiatives, 2020). Rural smallholders and workers, women and adolescents, and indigenous people generally face larger and more structural nutrition deficits that are linked to their absence of voice and bargaining power. Many policies and programmes focusing on food system transformation tend to overlook the informal trade and small-scale food services that cater to these disadvantaged groups (CHAPTER 6). Equitable food systems thus need to look beyond access to markets and resources, and to devote explicit attention to their participation in governance regimes and information systems.

What structural changes are needed to make food systems more inclusive, more resilient and more supportive of healthy diets?

Food systems can improve rural and urban diets by making a diverse portfolio of nutrient-dense foods available at more affordable prices. To do this, they need to bridge rural-urban economic and nutritional divides through better market linkages. They must reinforce food system interactions to strengthen the resilience to external shocks such as COVID-19.

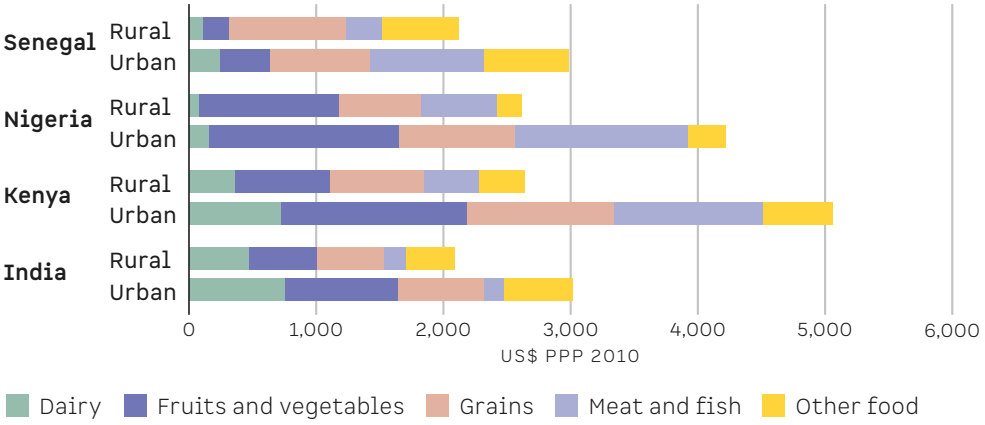
Rural areas lag behind urban areas in food spending, dietary diversity and food security

Urban and rural food expenditures differ in striking ways (**FIGURE 1.4**). Urban households have on average greater purchasing power, so they spend more on food: generally, total spending on food rises with income, even as the share of food spending gradually declines (Gandhi and Zhou, 2014). Urban households spend more on fruits and vegetables, and on ASF, for which demand rises from 5-10 per cent in low- and middle-income countries to more than 30 per cent in high-income countries (Dasi et al., 2019). Despite controversy around ASF, notably their climate impacts (see CHAPTER 2), they contribute to reducing iron-deficient anaemia and promote more optimal child development.

Rural households, by contrast, spend 20-30 per cent less on food, and their expenditures focus more on grains (de Bruin et al., 2021). In southern and eastern Africa, rural and urban middle-class diets become more diversified (Tschirley et al., 2015). In India, non-staples are becoming more important as shares of food expenditures in rural areas, where cereal expenditures fell from 41.1 per cent to 10.8 per cent (between 1971/72 and 2011/12), and in urban areas, where this share fell from 23.4 per cent to 6.6 per cent (Pingali et al., 2019).

FIGURE 1.4 PER CAPITA FOOD EXPENDITURES IN URBAN AND RURAL AREAS

PER CAPITA EXPENDITURE PER YEAR PPP$ 2010



Source: de Bruin et al., 2021.

As net buyers of food, most poor people in both urban and rural areas can obtain required food items only by purchasing them. In rural areas, farm production can provide some basic livelihood revenues. More generally, however, the incomes and revenues of poor people depend mainly on income from non-farm employment and from regular or temporary off-farm employment. Income from off-farm activities tends to support upward mobility, accompanied by greater dietary diversity.

Although food in urban areas is often more expensive in absolute terms than food in rural areas, cities have greater food security – simply because the average urban consumer has more purchasing power (Headey et al., 2018; Stage, Stage and Mcgranahan, 2010; Tibesigwa and Visser, 2016). In West Africa, for example, 18 per cent of the rural population is undernourished, compared with 13 per cent of the urban population (van Wesenbeeck, 2018). In Ethiopia, diet diversity is higher and affordable to more people in urban areas than in rural areas (Gebru et al., 2018), and gendered differences in food security appear generally lower in urban areas (Sharma et al., 2020).

Rural-urban food market linkages generate jobs and increase stable access to food – but, as food value chains lengthen, extra attention is needed to ensure food safety

Food markets are critical for guaranteeing stable access to a wide variety of food, and they can help to stabilize food prices where there is seasonal variation in food supply. Food is increasingly purchased through different market channels, ranging from local barter trade and open markets to corner shops and supermarkets. This access to different market outlets favours stable access to affordable food (Sibhatu and Qaim, 2018). Food markets also offer large employment opportunities – especially for women – and are critical for controlling food safety and limiting adverse environmental effects.

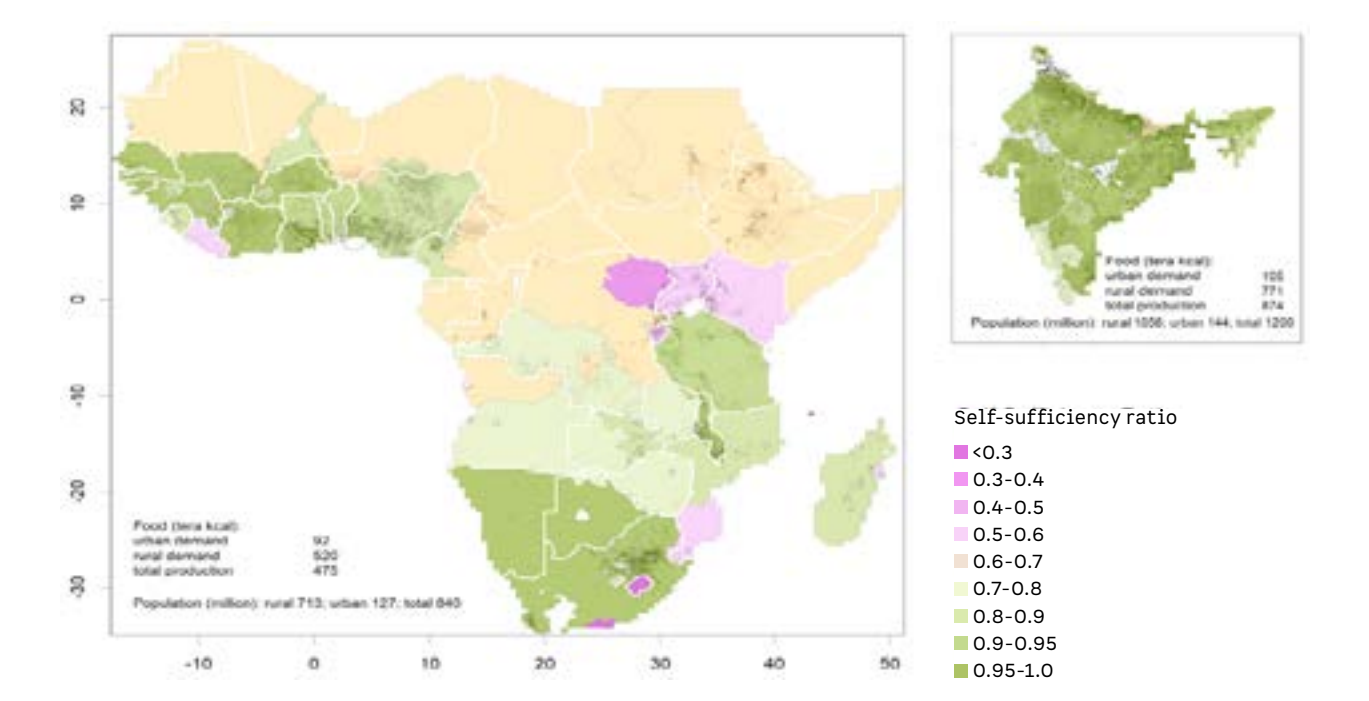
Access to a diverse basket of fresh and healthy food mainly depends on adequate connectivity, both physically (roads, warehouses) and in access to market information through digital apps and mobile devices that support food trade. These devices also support the growth of out-of-home food consumption and home delivery of fast food. To ensure a variety of food choices, consumers need stable access to a diversified portfolio of formal and informal food outlets, thus avoiding the risk of large areas with "food deserts".

Foodsheds – the regional networks of production and consumption integrating food markets through shorter supply chains – depend on well-functioning rural-urban linkages. In sub-Saharan Africa and India, the great majority of urban food comes from rural-urban supply chains and is reliant on domestic traders and wholesalers (see CHAPTER 6). An exception is East Africa: with its dense population, it depends on imports (**BOX 1.4**).

BOX 1.4 COMPARING FOODSHEDS BASED ON URBAN-RURAL LINKAGES: INDIA AND SUB-SAHARAN AFRICA

Foodsheds – which can differ greatly in size – are vital for reducing the dependence of urban consumers on food imports. Today, contrasting regional foodsheds appear in India and sub-Saharan Africa.

FOODSHEDS AND SELF-SUFFICIENCY RATIOS IN INDIA AND SUB-SAHARAN AFRICA



Note: Colour shading and grey boundaries show individual foodsheds around the main city (indicated with the open circle). In grey, masked by the semi-transparent foodsheds, food production (in kcal) is plotted.
Source: Analysis based on 2010 population and food production derived from the IMAGE global crop hydrology model, with losses based on FAO estimates (de Bruin et al., 2021).

At first glance, the two regions seem to differ little in their self-sufficiency: imports constitute just 3 per cent of food consumed in India, and just 9 per cent in sub-Saharan Africa. But those six percentage points indicate a substantial difference. India is currently in theory food self-sufficient – though only by a narrow margin (de Bruin et al., 2021) – even after 40 years of rapid growth in the urban share of national food expenditures (from 25 per cent in 1971 to 60 per cent in 2011 [Reardon et al., 2020]). By contrast, sub-Saharan Africa produces just 78 per cent of its overall food demand (excluding meat, fish and dairy). Only two regions in sub-Saharan Africa have the capacity to be fully self-sufficient: parts of West Africa and parts of southern Africa.

Source: de Bruin et al., 2021.

Strengthen food system integration to increase resilience against shocks

The devastating impact of COVID-19 on employment, nutrition and food security clearly shows that the current fragmentation of food systems makes people highly vulnerable to different types of shocks. Disruptions in food supply, and local hoarding, due to constraints in physical access and shortfalls in purchasing power are accompanied by increased uncertainty due to limited access to information and scarce foresight. The vast majority of small-scale entrepreneurs and informal self-employed people faced severe economic difficulties, essentially as a consequence of the preventive measures of mobility restrictions, lockdowns and curfews imposed by local and national authorities to reduce the spread of the virus (Béné et al., 2021).

Reinforcing the resilience capacities of food system actors in response to health, economic or climate crises can be based on strategies that simultaneously enhance risk-coping and reduce dependency: providing (temporary) social safety nets, diversifying local and regional food markets, reinforcing insurance mechanisms and building the capacity of midstream agents in the food supply chain.

What policies are most effective in shifting demand-side incentives to support healthier diets?

Enabling healthier diets that are safe and affordable generally requires shifts in diet composition and consumer demand. Consumer choices depend on availability and affordability, but are also influenced by appeal and convenience. Underused or ancient indigenous crop species can also contribute to the mix of food sources (Padulosi, Thompson and Rudebjer, 2013). Strategies for steering consumption towards healthier diets rely on communication and behaviour change and on economic, social and fiscal incentives.

Market conditions that favour healthier food choices can trigger changes in shopping, preparing and eating habits. Poor people thus need incentives, along with access to markets and information. Food taxes and subsidies can further steer consumer behaviour towards more nutritious food options (Thow, Downs and Jan, 2014). But today's subsidies on staples contribute to unbalanced diets by keeping staples cheaper than healthier products (Micha et al., 2020).

Financial and fiscal incentives can stimulate local rural development and sourcing from nearby hinterland producers. Incentives can also promote consumption in specific categories: indigenous foods, underutilized foods, and so on. Supporting dietary change sometimes involves imposing penalties and barriers on the consumption of less healthy foods and on obesogenic eating practices.

The most important specific and concrete incentives for changing food systems to support shifts towards healthier diets are:

- Strengthening social safety nets programmes and cash transfers (conditional or unconditional) for poor people to spend on diversifying food intake.
- Supporting women's empowerment and gender equality with targeted measures.
- Encouraging food preparation practices that improve nutrition.
- Improving nutrition through behavioural change communication.
- Using food quality labelling and marketing to inform consumer food choices.
- Promoting ICT-based market information systems and product imaging.

Social safety nets and cash transfers

Social safety nets are increasingly used to generate new and more productive employment and to safeguard food security. They are especially effective in reaching women, wage labourers and migrants and in creating purchasing power to support food demand. An estimated 36 per cent of poor people in low- and middle-income countries could escape extreme poverty in social safety nets – which include cash, in-kind transfers, social pensions, public works and school feeding programmes targeted to poor and vulnerable households (World Bank, 2018). Widely expanded as a response to the COVID-19 pandemic, these programmes had reduced the poverty gap by about 45 per cent in the last decade (World Bank, 2018).

Social transfers include vouchers for education programmes and health care programmes that provide preferential access to fruits, vegetables or dairy products. Such food voucher programmes offer an important nutritional safety net and potentially improve nutrition for pregnant women and young schoolchildren living on low incomes, and influence future food choices. Voucher values could, however, be affected by rising food costs, a lack of access to registered retailers and registration barriers (McFadden et al., 2014).

Women's empowerment – to earn income, control time and make strategic life choices

Interventions for women's empowerment can support desirable food system outcomes. But, to improve health and nutrition outcomes, interventions must be carefully designed to avert trade-offs among various dimensions of empowerment. In particular, attention must be paid to women's control over household resources and over their time use.

Because food decisions are made largely by women, empowering women with resources and agency will generally improve diets and nutrition. Sound evidence supports this positive association, showing that empowerment leads to improvements in:

- Maternal nutrition (and health outcomes, such as reduced anaemia).
- Child diets.
- Infant and young child feeding practices.
- Child anthropometric indicators.

Several studies using cross-sectional data find positive associations between women's empowerment and child nutritional status (Hindin, 2000; Shroff et al., 2009; Shroff et al., 2011).[4] Enhancing gender equity in food systems can thus support desirable health and nutrition outcomes by empowering women in food production, food purchasing and household consumption. More generally, widening women's opportunities to engage in the commercial food system may increase their ability to make strategic life choices. When women can engage more directly or more extensively in food system activities – either through formal employment or through increased participation in high-value products and value-adding activities – they can contribute more to household income and resources (Handschuch and Wollni, 2013; Said-Allsopp and Tallontire, 2015; Quisumbing et al., 2015). Often, such opportunities are correlated with greater control over income and related bargaining power within household relationships (Rubin, Manfre and Barret, 2009; Getahun and Willanger, 2018). Training and extension services are generally positively associated with women's empowerment, and the effect of education is also generally positive, though its strength varies by country (Quisumbing et al., 2021).

Enhancing gender equity in food systems can support desirable health and nutrition outcomes by empowering women in food production, food purchasing and household consumption.

Caution is needed, however, when designing policies to increase gender equality in labour markets linked to food systems. Women's increased involvement in food systems, by itself, does not automatically improve diets and nutrition outcomes for women or other household members (Quisumbing et al., 2021). And, while this increase can boost economic efficiency, it can also reduce women's control over assets if men take over the production and marketing of higher-value products. In this situation, women's lack of control over their earned income may disincentivize their engagement (Ashby et al., 2019; Djurfeldt, Dzanku and Isinika, 2018; Forsythe, Posthumus and Martin, 2016).

For gender-sensitive food system interventions to improve health and nutrition outcomes, it is not enough to focus solely on women's control of financial resources: their control over their time also needs to be considered. Diet, health and nutrition outcomes can reflect shifts in how women use their time, as more people migrate to urban areas and as women work more outside the home. These shifts have implications not just for childcare, but also for children's diets and nutritional status, as families rely more on the market for food (and less on their own production). So interventions need to pay close attention to women's control over their time use (Malapit et al., 2020).

[4] In addition, women's greater control of resources is associated with children's improved human capital outcomes – a link widely confirmed by both observational studies (Quisumbing, 2003) and experimental studies (Yoong, Rabinovich and Diepeveen, 2012).

Encouraging food preparation practices that improve nutrition

Incentives for improving food preparation – the proper use of food for diets that provide sufficient energy and essential nutrients – focus on practices for cooking and distributing food within the household (portion size, eating sequence, and so on). Homestead food production may support nutritious food intake for household consumption (Ruel, Quisumbing and Balagamwala, 2018). Adjustments in portion size and serving frequency can increase the fraction of children eating fruits or vegetables and can reduce waste.

Efforts to improve food utilization habits through training and extension programmes have fairly limited effect. More promising are innovative approaches through recipe exchanges and social media that promote chefs' practices (Lamstein et al., 2014). These innovative approaches can reach larger audiences, as with the Recipes for Change initiative promoted by IFAD during the last five years (**BOX 1.5**).

One way to modify food choices is to reduce women's time constraints by increasing the convenience of healthy food preparation. In Ghana, mothers provided more complementary foods for their children when their time for preparation and cooking was reduced (Pelto and Armar-Klemesu, 2011; Jackson and Viehoff, 2016). Higher fruit and vegetable consumption is associated with fewer hours per day spent in preparing, cooking and cleaning up (Monsivais et al., 2014). In rural areas, easier access to fuelwood and water increases the time available for food preparation among lower-income groups. In Malawi, women who spent 6-10 hours each week gathering fuelwood cooked cereals and beans less often (Brouwer et al., 1996). In urban areas in India, families that own a pressure cooker were better protected against severe food insecurity (van Elsland et al., 2012).

BOX 1.5 IFAD'S RECIPES FOR CHANGE

Chefs have been visiting IFAD projects on the ground to raise awareness of how IFAD is working with farmers to build a resilient future. Partnering with celebrity chefs from around the world and rural communities in developing countries in Africa, Asia and Latin America, IFAD shows how positive change can be brought into the recipes of up to 8 million people. But it is not just about the food on people's plates; Recipes for Change looks at the threats communities face – from climate change, daily life and difficulties, and more recently the COVID-19 pandemic – that affect some of the essential ingredients used in their main meal of the day. It shows how IFAD is working with farmers to adapt to the very real impacts of climate change in their communities, and it highlights the links between gender, youth, nutrition and the climate- and environment-sensitive investments supported by IFAD.

Source: https://www.ifad.org/ar/web/latest/recipes-for-change.

Using product labelling and marketing to inform consumers about nutrition

Product labelling and nutrition information can educate consumers about a food product's nutritional value, production (such as fair trade and decent living standards) and environmental footprint. Although most labels are voluntary, uniform public standards are increasingly appreciated to guarantee a level playing field for the food industry. Voluntary eco-friendly and fair trade labels lead to market segmentation and influence consumer demand only slightly.

Some evidence exists for the effect of social marketing campaigns on healthy eating behaviour (Abril and Dempsey, 2019). The length of campaigns (longer than six months) is considered a critical success factor. Private-sector food companies are also investing in healthy choice campaigns, not only in high-income countries (for example Unilever's Cheat on Meat campaign in the UK, Eat more Veg campaign in the Netherlands) but also in low- and middle-income countries (Green Food Steps in Nigeria, Nutrimenu in Indonesia).

The long-term impact of labelling on healthy food choices remains undetermined, and its effectiveness requires complementary investment in consumer education. A review of nutrition labelling studies in the Global South indicates that consumers like to have nutrition labelling on pre-packaged foods, but their use and comprehension is low (Mandle et al., 2015). Government-endorsed nutrition information is appreciated if it is clear, easily visible and standardized and includes symbols or pictures. In South Africa, food prices remain a more significant consideration than quality and nutritional value among poorer consumers when selecting food products (Koen et al., 2018).

Promoting ICT-based market information systems and product imaging

Information and communication technologies offer important new prospects for steering consumer behaviour towards healthier and sustainable diets. Improved connectivity, access to information and peer-to-peer sharing provided by ICTs such as mobile phones, radio and the internet influence consumer behaviour (GSMA, 2018, 2019). They could also improve food market transparency and stabilize food prices. Digital solutions that rely on e-commerce and consumer-to-consumer exchange contribute to better product tracing and an improved bargaining position of consumers.

Online interventions might change dietary behaviour using techniques such as goal-setting, self-monitoring, and providing instructions and feedback (Young et al., 2019). App-based interventions to improve diet, physical activity and sedentary behaviour are more effective using an integrated multi-

component approach (Bray et al., 2016; Shoeppe et al., 2016). There is still an important coverage gap (people living in areas with no mobile broadband) and usage gap (people not using mobile services) in connectivity in the Global South, which is highest in sub-Saharan Africa, where 31 per cent of the population experience a coverage gap and 45 per cent a usage gap (GSMA, 2019).

Evidence is still modest for the impact of m-Nutrition services on behaviour change, as a result of the lack of sustainable business models and the ineffectiveness of push messages (Barnett et al., 2016). A review of 15 m-Health studies in Asia and Latin America showed that 50 per cent of the interventions were effective in increasing physical activity, and 70 per cent of the identified interventions influenced diet quality (Müller et al., 2016). But m-Nutrition services in Ghana and Tanzania did not always reach poor households or women and had a limited effect on nutrition behaviour at scale.

What public investments are needed to promote healthier diets and a more inclusive food environment?

The food environment largely determines the solution space and opportunities for improving food access, availability, affordability and quality. Nutrition improvements require a food environment that enables rural and urban consumers to adopt healthy diets – and these diets should also be sustainable. To create such an enabling food environment requires public investments and laws that can steer social norms and cultural practices for various categories of consumers.

Food system performance will improve only if food supply systems are tailored towards shifting patterns of consumer demand, supported by an inclusive, reliable and trusted food environment. To achieve the nutrition transformation outlined in this chapter, policymakers must focus on contextual factors that influence the conditions for balanced and diverse food demand, and support nudging towards healthier and more sustainable dietary choices. Supply-side and demand-side initiatives can jointly support desirable food system transformation, as in the example provided in **BOX 1.6**.

The most important and concrete changes for supporting an enabling food environment – combining coercion with seduction – include:

- Legislation and capacity-building.
- Tariffs, taxes and subsidies.
- Food-based dietary guidelines.
- Co-investment for food fortification.
- Governments' institutional procurement.
- Behavioural change communication and nudging.

BOX 1.6 PROMOTING AGRICULTURAL COMMERCIALIZATION AND ENTERPRISES IN BANGLADESH

The Promoting Agricultural Commercialization and Enterprises Project aims to enhance the livelihoods of the poorest in rural Bangladesh through financial services, value chain development, and technology and product adaptation. It works to improve businesses for microentrepreneurs and small-scale farmers through self-employment opportunities. By adjusting value chain operations and empowering small-scale producers, it aims to create a more equitable and sustainable food environment – and to benefit women (64 per cent of beneficiaries are female).

Production of previously non-existent crops, such as mung beans, skyrocketed because of private investment and subsidies. Some 400 farmers increased their agricultural income by 25 per cent from increased production and reduced fertilizer expenses. Although nutrition was not a primary focus at the start, the project adopted several nutrition-focused activities. The adjustments to the food environment through technology and investment resulted in better food safety and nutrition. The increased production of nutritious products such as fruits, vegetables, meat, eggs and dairy improved dietary diversity for some of the poorest rural communities. Nutrition education enhanced awareness and consumption of healthy and balanced diets.

Source: IFAD project completion reports and impact assessments.

Legislation and capacity-building

In the informal settings where most poor people buy their fresh and perishable food, rules for the quality and safety of food are absent, a situation compounded by poor governance and corruption. Legal measures that define minimum safety standards and limit chemical residues and added components in food are difficult to enforce. There is little trust in government certification, as much of the food sold does not meet official standards, and food certified as safe is not always safe. Most legislation and investment in food quality and safety focuses on access to export markets, with little done to support local consumers.

Compliance with Codex standards and guidance recognizes that achieving food safety requires well-planned, risk-based farm-to-table efforts that link private-sector responsibility with government oversight. Support for rules and capacity-building combined with public infrastructure investments and greater emphasis on harnessing consumer awareness can drive progress.

Tariffs, taxes and subsidies. Tariffs, tax regimes and subsidies that focus on modifying (relative) prices of nutrient-rich foods, staples and UPF are used to influence consumer choice and could generate public revenues for improving the food environment. Governments can intervene in markets in ways that lower the prices of healthier foods relative to those that are consumed sufficiently or to excess. It is also possible to directly subsidize the production or marketing of more nutrient-dense crops.

Conversely, prices of overconsumed unhealthy foods can be increased by a sugar or fat tax. The sugar taxes in Mexico and food warning labelling in Chile reduced consumption of sugary beverages as well as UPF. Interestingly, some

of this is due to consumer behaviour change, while some is caused by reactive product reformulation by food companies.

Food-based dietary guidelines. Global and national food-based dietary guidelines are underused as tools for informing investment strategies, both in agricultural development (such as research focused on fruits and vegetables, rural-ready cold chains) and in safety nets tailored to facilitate access to diets that meet dietary criteria (such as distribution of seeds or other supplies for homestead food production). Although there is some evidence of consumer understanding and adoption of such guidelines (Brown et al., 2011; Keller and Lang, 2008; Nguyen et al., 2015), little is still known on the impact of using them in public policies or investment programmes towards healthy diets.

Co-investment. Global international investments to support food fortification and biofortification breeding programmes (mainly in staples) through conventional plant breeding or modern biotechnology are used to address micronutrient deficiencies and reduce hidden hunger. Almost 370 biofortified varieties of 11 staple crops have been released in 41 countries, delivering biofortified seeds to 40+ million people. Because the efficacy and effectiveness of biofortified crops for improving micronutrient status and health outcomes has been widely proven, cost-effective biofortification investments and delivery models through partnerships with multilateral programmes and private investors can support further upscaling.

Governments' institutional procurement. Governments can use their own institutional procurement for supporting dietary change, such as healthier school meals, office canteens and food procurement for hospitals and prisons. Such public procurement programmes have proven effective in responding to immediate needs and providing opportunities for linking local and regional food economies towards more sustainable consumption patterns. Specific bidding procedures can be developed to enable sourcing from smallholder producers. In 2019, 17.3 million schoolchildren received nutritious meals and snacks from the World Food Programme in 59 countries. Spillovers of institutional meals to home consumption remain challenging.

Behavioural change communication and nudging. Because food choices are heavily determined by custom and tradition, targeted programmes for behavioural change communication can be effective for changing nutrition practices. Such programmes aim to increase the demand for vegetables, fish or poultry products while mitigating their potential negative externalities. Most effective programmes work simultaneously on community sensitization, household decision-making and women's empowerment.

Growing evidence attests to the impact of nutrition-focused behavioural change communication in low- and middle-income countries, especially to improve infant and young child feeding practices, with a positive impact on breastfeeding practices and to a lesser extent on complementary feeding (Benedict et al., 2018; Lamstein et al., 2014; Webb Girard et al., 2020). Impact at scale is realized in Bangladesh, Ethiopia and Viet Nam using a mixture of communication channels and approaches at the individual, household and

community levels and focusing on a limited number of actionable messages (Kim et al., 2020; Menon et al., 2016).

Consumers can also be steered towards healthier diets by nudges based on social norms and cultural practices: such nudges lead healthy eating to become less about choices, more about habits. Differences exist among cognitive nudges (using information and labelling), affective nudges (based on pleasure and encouragement) and behavioural nudges (improving convenience, changing portion size).

Several nudging strategies based on convenience and social norms result in healthier food choices (Arno and Thomas, 2016). Studies in high-income countries found consistent evidence that social norms and aspirations influence food choices: information indicating choices made by others significantly increased the likelihood of participants making similar choices (Robinson et al., 2014b). In an experimental setting, a social norms statement about peers' fruit and vegetable consumption proved more effective than a health benefit statement (Robinson et al., 2014a). The diet behaviours of children, adolescents and parents can mutually influence each other (Draper et al., 2015).

Generally, the most effective behavioural change communication and nudging strategies involve information provision (social media, labelling), the use of social norms, changes in default choices and adjustments in the physical environment (Bauer and Reisch, 2019). Although nudging cannot entirely replace legislation, it can influence daily food and beverage choices.

Simulation 1 in annex 1 illustrates how imposing a healthy and sustainable flexitarian diet, against a business-as-usual baseline, supports the poorest agricultural workers while keeping more people in agriculture and increasing food prices.

Policy priorities for a shift towards healthier diets

To achieve the inclusive nutrition transition envisioned in this chapter, policymakers must provide both market-based incentives and direct public investments that steer food consumption choices towards safer, healthier and more affordable diets. Supply-side initiatives should be tailored to support business innovation. Demand-side initiatives should employ fiscal incentives while also disseminating information to encourage healthier food choices. Public investments must especially target poor people who are net buyers of food, including those who depend on social safety nets or institutional food provision programmes. Finally, policy discussions must include attention to critical trade-offs among nutrition, environment and inclusion.

Specifically, policymakers should:

Focus the food policy agenda on tailoring public investment programmes and government procurement, combined with responsible private-sector innovations and market incentives to diversify diets and make food choices heathier and more sustainable. In particular:

- Reduce critical nutrition gaps by combining food (quality and price) information systems, measures for guaranteeing stable market access and gender-targeted food schemes. Depending on the context, targeting specific groups, such as minorities and indigenous peoples, may be needed.
- Support a shift in consumer demand patterns among poor people who are net buyers of food towards a better, affordable portfolio of nutrient-rich foods.
- Steer private-sector investments towards the production and marketing of high-quality food items through varied types of local food outlets that are close to consumers, provide convenience and maintain short rural-urban linkages.

Use market-based incentives and innovation programmes to support poor people's food purchasing power and women's bargaining power – and enable them to make better-informed food choices through training, labelling, communication and digitalization.

Promote the establishment of a supportive food environment that uses legal and regulatory regimes (with grades and standards), as well as fiscal measures, to support affordable food prices in favour of nutrient-dense foods; to enhance investments in improving food safety in competitive and transparent food markets (formal and informal); and to shape social norms and practices in favour of nutrient-rich foods and diversified diets that can be sourced from local producers and processors.

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CHAPTER 2

Seeking synergies for health, inclusion and the planet – in animal production systems and animal-sourced foods

Today, animal production systems and animal-sourced foods (ASF) are in the limelight because of the debate around the fear that increasing global demand for ASF could take us beyond planetary boundaries and also have nutritional impacts. There is concern about ASF production being less efficient and more wasteful than production of crop-derived foods, while land suitable for food crops is increasingly used for feed and a rising number of concentrated farm animals imposes direct environmental burdens – greenhouse gas (GHG) emissions and soil and water pollution – along with health pressures linked to zoonotic diseases and antibiotic resistance. In addition, underconsumption and overconsumption of ASF are regarded as detrimental to human health and a burden on health-care systems.

In a world with a growing population, increasing urbanization and globally rising average wealth, rising demand for ASF certainly warrants concern. That said, the implications of rising ASF production are mixed: along with its many risks, it brings some benefits. Underconsumption, as well as overconsumption, of ASF can pose health threats and impose burdens on health-care systems. So increasing amounts of ASF in diets should not be seen as a solely negative development. Further, ASF production systems and intake vary tremendously across and within regions and countries, while their effects vary by production system, ASF group and product type. Despite this, many animal production systems contribute to circular systems, recycling organic by-products and waste, providing manure to land under food crops and using pastures that cannot be used as arable land. Chicken and aquaculture-based systems are good examples of such circular systems.

This chapter develops five messages:

1. **Animal production and ASF intake increase sharply with population growth, urbanization and rising incomes – creating environmental burdens that differ by animal group and production system type.** Animal production is generally less efficient (output per unit of input) than plant production, potentially putting a large burden on land and water resources – but efficiency ranges considerably across animal groups and production systems worldwide.
2. **Consuming ASF has important health and nutrition benefits, particularly for young children, but in excessive amounts it can also harm health.** Both insufficient and excessive ASF intake pose disease risks and can burden health systems.
3. **Animals are part and parcel of rural livelihoods, with meanings beyond food production.** The significance of keeping animals varies in ways that reflect and have implications for gender roles. Kept animals need care throughout the year, can provide income throughout the year and have socio-economic and cultural significance.
4. **The expansion of ASF production systems contributes to major global environmental worries through food-feed competition, land and water degradation and pollution, and rising GHG emissions – yet these concerns are not chiefly associated with rural smallholder production.** Small-scale animal farming households are not a principal environmental threat.
5. **Depending on the animal group and production system, certain farm animals, fish and ASF – including novel proteins – show great promise as drivers of circular food systems.** In particular, developing and scaling novel proteins can help meet increasing global ASF demand.

Can the world keep up with increasing ASF intake?

ASF intake varies widely across countries and regions (**BOX 2.1**). Rising ASF demand has three main drivers: population growth, urbanization and rising incomes. The elasticity of ASF demand to income is relatively high: in low- and middle-income countries, even slight income gains from low initial levels tend to shift dietary composition in favour of ASF.

BOX 2.1 CLASSIFYING ANIMAL GROUPS FARMED FOR FOOD – AND TYPES OF ANIMAL PRODUCTION SYSTEMS – IN LOW- AND MIDDLE-INCOME COUNTRIES

Animals raised in low- and middle-income countries belong to four food groups:

- **Cattle** are kept for meat production (beef cattle) or for milk production, but also as a "mobile bank account". They have many additional functions: they provide draught power for land preparation, they produce manure for crop fertilization, they are kept as capital assets and for insurance, and they signify social status (Moll, Staal and Ibrahim, 2007; Oosting, Udo and Viets, 2014). In South and South-East Asia, water buffalo are as important as cattle for milk production and for tilling rice fields.
- **Sheep and goats**, together referred to as small ruminants, are important livestock species for poor people (Udo et al., 2016. The income derived from keeping goats and sheep is, however, relatively low. Goat and sheep populations are growing in Africa and Asia by about 2.5-3.5 per cent annually for goats and 1.1 per cent annually for sheep, which is slightly higher than the growth in cattle populations on both continents (Mazhangara et al., 2019). Goats and sheep are kept for meat, have a key role in religious festivities and are a small capital asset to be sold for cash.
- **Pigs and poultry** are monogastric, implying that they need higher-quality feed than do cattle, sheep or goats. Pigs and poultry are kept either in backyard systems, where they scavenge their own feed supplemented with household waste, or in intensified systems, which require investments in housing, feed and disease control. In low- and middle-income countries, intensive pig and poultry production is the fastest-growing livestock sector, and it is seen as the major supplier of ASF of the future (Herrero et al., 2013).
- **Aquaculture**, or fish farmed in ponds, encompasses three types of species: herbivore, omnivore and filter-feeding. All types allow for the inclusion of plant-based by-products in feed (Hua et al., 2019). Ponds are production systems, but they are also complete ecosystems in which algae grow on nutrients from waste streams such as livestock manure, kitchen waste and supplementary fertilizer (Pucher and Focken, 2017). Sediment from fish ponds may be used as a fertilizer.

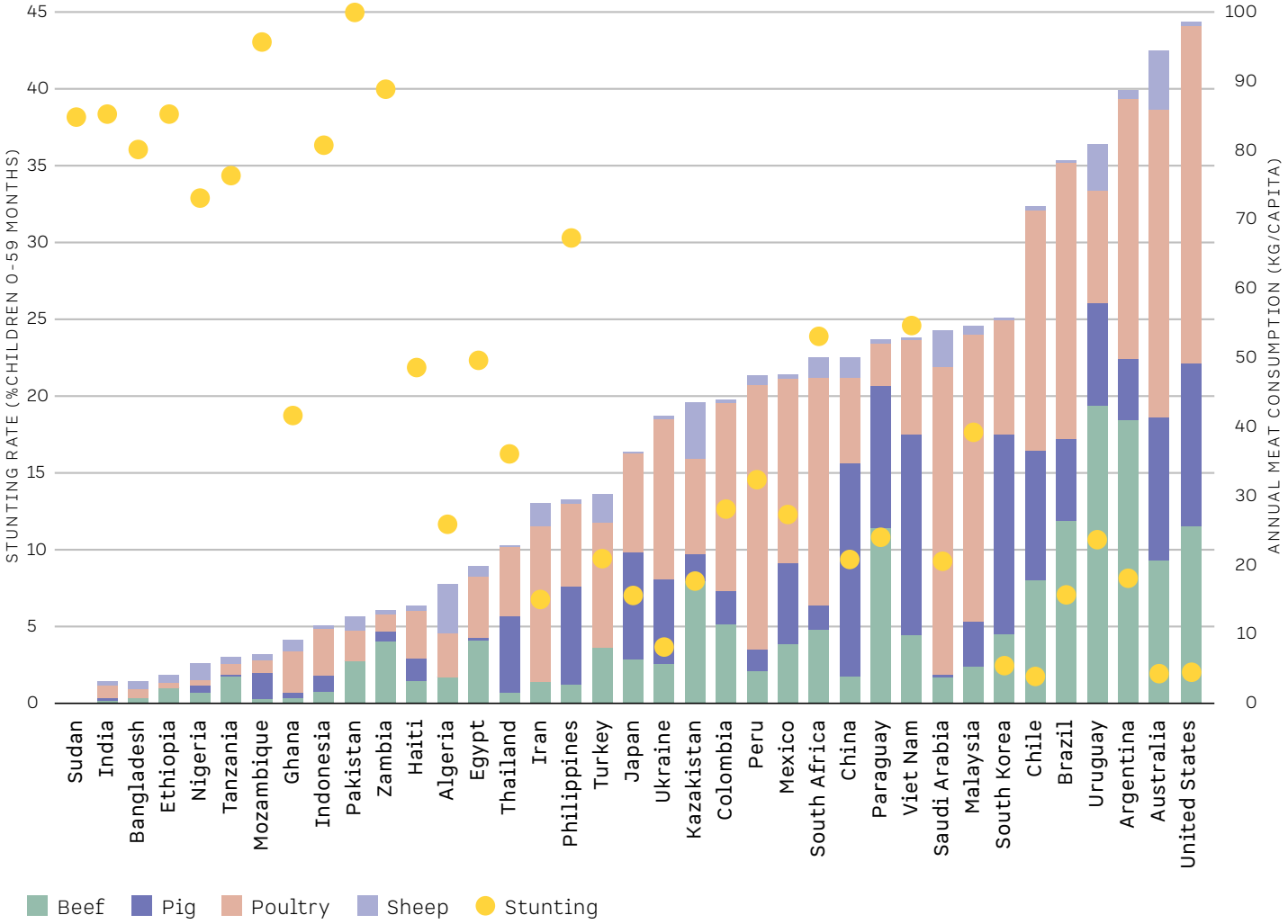
Four types of animal production systems can be broadly distinguished:

- **Dryland grazing.** In dryland regions, mobile grazing systems with pastoralists herding ruminants are dominant. Dryland regions are too dry for crop production, and herding is the only agricultural activity supporting livelihoods. Traditionally, pastoralist systems exist in symbiosis with crop systems, in part because of the exchange of food obtained from sedentary agriculturalists but also because pastoralists require grazing on crop residues during the dry season, whereas crop farmers benefit from manure deposited during grazing.
- **Semi-arid to semi-humid grazing.** In regions with semi-arid to semi-humid conditions, animal rearing is generally limited to grazing ruminants for meat production. These regions could potentially be used for crops: some were once covered by forest. In some areas, deforestation and use as cropland has depleted the soil and left extensive ruminant production on grassland as the only possible economic activity. Meat production is often a two-stage activity: the first consists of a relatively long pre-fattening period, with low growth rates on relatively poor pastures (and thus with relatively high GHG emission intensities), followed by a second stage – intensive fattening at feedlots.
- **Mixed crop, livestock and aquaculture systems.** Because of their relatively favourable conditions, these systems are found in relatively densely populated regions, where farms are small. High levels of integration between farm activities are observed; various species of livestock are kept to feed on residues of crop production and household waste – and on collected grass or by grazing on communal lands and along roadsides. Manure is used as fertilizer or as substrate for fish production in ponds, and pond sediment may then be used as fertilizer.
- **Industrial and semi-industrial systems.** These systems – often producing poultry, pigs, aquaculture or dairy – are found in densely populated regions with nearby markets and good infrastructure – conditions that allow feed supplies, good market linkages and limited transaction costs. Productivity is high, so GHG emission intensities are relatively low. Because industrial systems use high-quality feeds (for example maize and soybean, often as soybean meal), land and water use for industrial and semi-industrial systems compete with human food crop production.

Global ASF intake shows a wide range

Differences in ASF intake across countries, regions and incomes are staggering (**FIGURE 2.1**). Whereas high-income countries, Latin American and East Asian countries are all at or above 30 kg per capita per year, all countries in the Middle East and North Africa, sub-Saharan Africa and South Asia are below this level. Mean annual per capita meat consumption in the bottom four meat-consuming countries (Bangladesh, Ethiopia, India, Sudan) is less than one thirtieth of that in the top four (Australia, Brazil, the United States, Uruguay). Across IFAD regions, Latin America and the Caribbean consumes the most bovine meat per capita, on average twice as much as East and Southern Africa and Asia and the Pacific, and three times as much as West and Central Africa. East Asia ranks high on pig meat, Latin America on beef, and the Middle East and North Africa on sheep. Poultry is important everywhere.

FIGURE 2.1 MEAT CONSUMPTION PER CAPITA AND STUNTING RATE ESTIMATES IN DIFFERENT COUNTRIES



Source: OECD, 2018 and UNICEF, WHO and World Bank, 2017.

Aquatic foods are not included in **FIGURE 2.1**, but the world's appetite for aquatic foods is great and growing, mainly through fish farming. Consumption has doubled in the past 50 years (**BOX 2.2**).

Meat intake is inversely related to child stunting rates (see **FIGURE 2.1**). Although this association at country level cannot be interpreted as evidence of a causal relationship, it may reflect the income elasticity of some ASF, including meat. That said, it supports the hypothesis that ASF consumption benefits child growth (Headey, Hirvonen and Hoddinott, 2018; Pimpin et al., 2019).

While the consumption of ASF varies widely within and across countries and regions, the geographical distribution of livestock is also important for transforming food systems (**BOX 2.3**).

BOX 2.2 COASTAL COMMUNITY DEVELOPMENT IN INDONESIA

Millions of people in Indonesia rely on healthy fishing markets for their livelihood. Limited and inefficient fishing gear combined with poor infrastructure stifles the growth potential of the fishing industry.

An IFAD project implemented between 2013 and 2017 was designed to address poverty and achieve sustainable economic growth in 12 coastal districts. The goals included marine and coastal natural resource management. Beneficiaries were provided with improvements to fishing activities, such as motorized boats and improved infrastructure for markets, processing centres and storage facilities. Investments restored the coastline with mangrove; established rotational rules for fishing points; and supported aquaculture, ecotourism, and fish processing, packaging, distribution and marketing. The project implemented several sustainability measures, including the establishment of fish-processing groups, with the primary goal of engaging women in processing and marketing.

Fishing productivity rose by 79 per cent, market access increased by 28 per cent and post-harvest losses fell by 5 per cent. Coastal resilience efforts were designed to ensure the longevity of the market and prevent overfishing. Coastal resource governance was also strengthened, allowing the government to assume responsibility for the project.

Source: IFAD, Coastal Community Development Project, Indonesia impact assessment technical peport and policy brief.

BOX 2.3 MAPPING THE GLOBAL DISTRIBUTION OF FARMED ANIMALS

Global datasets on the geographical distribution of livestock are essential for diverse applications in agricultural socio-economics, food security, environmental impact assessment and epidemiology. Gilbert et al. (2018) presented the latest version of the Gridded Livestock of the World (GLW3) database, reflecting the most recently compiled and harmonized subnational livestock distribution data for 2010. That version provides global population densities of cattle, buffalo, horses, sheep, goats, pigs, chickens and ducks in each land pixel at a spatial resolution of 0.083333 decimal degrees (approximately 10 km at the equator).

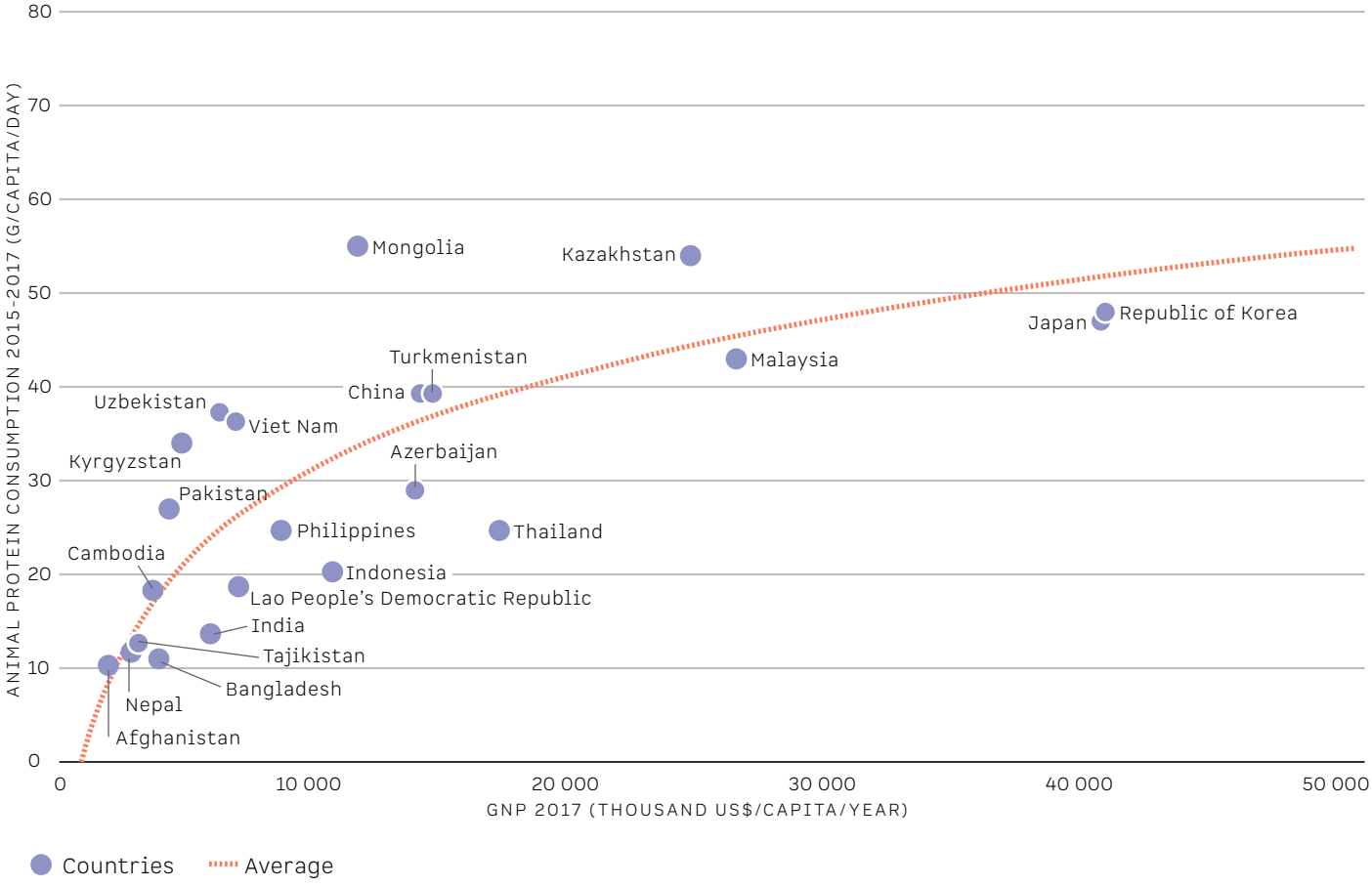
Note: Regional development of ASF demand and intake is mapped and reported by FAO in its *World Agriculture Towards 2030/2050* series.

Demand for ASF increases sharply as incomes rise – even where incomes are low

The income elasticity of demand for ASF is high: a rise in income prompts a considerable rise in demand (Speedy, 2003). Rising incomes thus shift consumption from plant-sourced food to ASF. Even small increases in the income of poor households lead to relatively large increases in ASF consumption.

The proportion of dietary energy from ASF varies and is often high in high-income countries (above 30 per cent) compared with low- and middle-income countries (5-10 per cent) (Dasi et al., 2019). Among low-income countries, those in Asia see an especially high rise in ASF consumption per unit increase in income (**FIGURE 2.2**). In these Asian countries, daily per capita animal protein consumption rises with GDP until it plateaus at 50-60 grams. The pattern is similar in sub-Saharan Africa, but less so in Latin America, where meat consumption is already at the higher end (Muhammed et al., 2017).

FIGURE 2.2 GNP AND PER CAPITA ANIMAL PROTEIN CONSUMPTION IN ASIAN COUNTRIES



Source: Oosting et al. (2021); derived from FAOSTAT (2020a) www.fao.org/faostat.

Where do animal production systems and ASFs fit in the health-sustainability-livelihoods triangle?

The simple answer: in every angle. Animal production systems and ASF have pronounced but varying implications for nutrition and health, inclusive livelihoods and sustainability (**TABLE 2.1**).

TABLE 2.1 SELECTED BENEFITS OF ASF FOR THE THREE FOOD SYSTEM OUTCOMES

AREAS	BENEFITS
Nutrition and health	– High-quality proteins, with adequate combinations of all nine essential amino acids (Semba et al., 2016) and with vegetarian/vegan diets requiring careful combination of foods to achieve protein adequacy (Mariotti and Gardner, 2019). – High contribution to essential micronutrient intake: high nutrient density, higher bioavailability (such as iron, zinc, calcium, vitamin A), important in preventing micronutrient deficiencies such as anaemia, which disproportionately affects women of reproductive age and adolescent girls in low- and middle-income countries (Grace et al., 2018; WHO, 2008). – Only dietary sources of vitamins B12 and D (GAIN, 2020), with vegetarian and vegan consumers showing high deficiency prevalence (Pawlak, Lester and Babatunde, 2016). – Animal proteins are 20-30 per cent more digestible than plant proteins (96-98 per cent versus 65-70 per cent) (Murphy and Allen, 2003). – ASF contains bioavailable compounds such as iron and preformed vitamin A; iron helps with blood formation while vitamin A is important in cognitive and physical development of children (GAIN, 2020; Murphy and Allen, 2003). – Milk and eggs improve linear growth in young children if provided regularly and in appropriate amounts, and meat improves cognitive development (Grace et al., 2018).
Inclusion	*Economic inclusion* – Role in rural poverty reduction: income, jobs and livelihoods – livestock-keeping is the main livelihood for around 1.3 billion people worldwide (Herrero, 2009). – Cash/bank functions – financial security for health, education, and so on. – Provision of draught power and fuel for subsistence agriculture.
	Social inclusion – Cultural beliefs, values and norms – celebrations and a sense of belonging drive tendencies to produce and consume ASF in many cultures. – Women are more likely to control the milk and eggs economy, and obtain income and assets, which are more likely to result in nutrition benefits for the family. – ASF and animals are frequently a mark of social status. – Ethnic minorities are often more livestock dependent than majority cultures. – Milk is a culturally valued component of many diets in low- and middle-income countries. – Many derived psychosocial benefits from ownership of livestock.
Environmental sustainability	– Ruminants can convert biomass unsuitable for consumption into high-quality food, so not all the land used is in competition with crop production. They can also use land that is unsuitable for crop production. – A large part of livestock's environmental footprint stems from feed production, but extensive systems in low- and middle-income countries use grass, crop residues or scavenging in backyards. – Manure from livestock can be cycled back to crop production, reducing the need for chemical fertilizers.

Source: Based on Dominguez-Salas et al., 2019.

Excess consumption or underconsumption of ASF? The health and nutrition pathways to desirable transformation

Despite much controversy around ASF, its high nutritional value contributes to nutrient adequacy. ASF is especially noted for preventing iron-deficiency anaemia in women of reproductive age and in young children, and supporting motor and cognitive development in young children (Neumann et al., 2003; Grace et al., 2018). Although human beings can live without consuming ASF, vegan diets present a challenge for a balanced nutrient supply – a challenge that requires special knowledge and access to a diverse food basket. Because poor people often lack this knowledge and access, many countries have included ASF in their national dietary recommendations (NDRs; FAO, 2018; **BOX 2.4**).

Protein consumption from ASF is close to 60 grams per capita per day in high-income countries, but the global average protein consumption from ASF under the NDRs of individual countries is in the order of 30-40 grams per capita per day (Matena, 2018). Despite the direct benefits of ASF intake for poor people, in specific circumstances ASF can also be overconsumed:

- In Africa and in Asia, poor strata consume considerably less than the NDRs.
- In Africa, rich strata consume roughly the NDRs, with overconsumption in some countries.
- In all other continents, rich strata overconsume, with consumption higher than NDRs (Matena, 2018).

Overconsumption and underconsumption of ASF can coexist within countries, so meeting NDRs is partly a matter of distribution. Overconsumption of ASF from terrestrial livestock is unhealthy, because the fat in ASF is rich in saturated fatty acids, and high ingestion of such saturated fatty acids may cause hypercholesterolaemia and cardiovascular disease (Brouwer et al., 2021; Oosting et al., 2021).

Foodborne diseases (FBDs) are also relevant when it comes to ASF (Grace, 2021). Meat consumption is a strong predictor of FBD mortality. In a cross-country study, for every additional metric ton of meat consumed per 100 people, FBD mortality increased by 6 per cent (Hanson et al., 2012). Food consumption is determined by culture, religion, values and beliefs, and the riskiest foods are often the most nutritious and the most societally valued. In

BOX 2.4 NATIONAL DIETARY RECOMMENDATIONS AND ANIMAL-SOURCED FOODS

National dietary recommendations (NDRs) are country-specific dietary guidelines addressing public health and nutrition priorities and accessibility of foods. Nutritional reasons to include ASF in NDRs include providing proteins with a high bioavailability and an amino acid profile that meets human requirements (Elmadfa and Meyer, 2017). ASF constitutes important sources of micronutrients such as zinc, selenium, iron, vitamins A and B12, and folic acid (Biesalski, 2005). Aquatic ASFs are also a good source of highly unsaturated fatty acids.

Ethiopia, raw meat is consumed. In Uganda, people consume raw eggs in the belief it will cure illness. In West Africa, pastoralists believed raw milk could not cause illness. And in South-East Asia, widespread consumption of raw, undercooked blood and raw fish leads to several zoonoses (Nasinyama, Cole and Lee Smith, 2010; Carrique-Mas and Bryant, 2013; Roesel and Grace, 2014; Seleshe, Jo and Lee, 2014).

Linkages between human and animal health are tackled through the One Health approach, a collaborative, multisectoral and transdisciplinary approach applied at different spatial levels. The aim is to achieve optimal health and well-being outcomes, recognizing the interconnections among people, animals, plants and their shared environment. IFAD, the Food and Agriculture Organization of the United Nations, the World Health Organization and the World Organisation for Animal Health collaborate to ensure that investment projects adopt this design approach and to support policy engagement for scaling up.

One challenge tackled by One Health is antibiotic resistance – when bacteria change after exposure to antibiotics and become more difficult to treat. The overuse of antibiotics in some intensive animal production systems can drive such resistance. One Health approaches have a high impact in combating antibacterial use and antibiotic resistance by combining human, animal environmental use and transmission pathways rather than treating them separately (Booton et al., 2021). They also curb the further spread of zoonotic diseases, such as COVID-19. The virus has been associated with traditional informal markets, or fresh produce markets (sometimes called wet markets). These markets sell fresh meat, fish and other perishable agricultural produce. Some sell live poultry and other domesticated animals, many sell live aquatic products (fish and shellfish) and some sell live or dead wild animals. The products can be sourced from many different places, including distant parts of the world.

There is a general consensus that informal markets can be epidemiologically risky – especially those selling live domesticated animals or live or dead wild animals and those with poor hygiene. But expert opinions differ on whether live animal markets should be regulated more strictly, upgraded gradually with buy-in from vendors, or banned completely to reduce disease transmission risk (Grace, 2021). Note that strict regulation of food has proven difficult in governance-poor contexts, where banning desired products often shifts the market underground.

Informal, traditional and fresh produce markets have many benefits for people, including low prices, ease of access, the availability of preferred fresh and traditional foods, income-earning opportunities for women, worker independence and attracting tourists. But these benefits need to be weighed against the wider costs to humanity – starting from local people – of failures to prevent disease outbreaks and global pandemics (Grace, 2021). Regulation may also support more effective protection of forest and wild species. In response to COVID-19, China is changing the Wild Animal Conservation Law to follow One Health thinking, to restrict invasions of nature conservation

areas and avoid close contact with organisms spreading zoonotic diseases (Fang and Song, 2021).

Keeping animals is more than running a food store

Animals mean more to rural people than just food. They are part of livelihoods – in many different ways – and in many cases and countries, they contribute to social status. In many low- and middle-income countries, livestock is widely seen as a store of wealth, in addition to providing power for land preparation and agricultural tasks and being a source of food and income. As a store of wealth and capital, they serve as a buffer stock for bad times, when distress sales of animals can compensate for crop income failures (Dercon, 1998; Fafchamps, Udry and Czukas, 1998; Kazianga and Udry, 2006).

Gender roles in animal management are varied and have been insufficiently understood in policy discussions of ASF, as have the wider economic and cultural roles of livestock in the household and in the community. For coastal fisheries and aquaculture, studies focusing on women and gender are progressing slowly because they are not on policy agendas or in action plans and do not receive substantial resources (Williams et al., 2012). As the world's fastest-growing food production sector, aquaculture generates significant employment opportunities at multiple scales – but there is a paucity of high-quality sex-disaggregated data on aquaculture value chains, especially on the distribution of benefits in the chain (Kruijssen, McDougall and van Asseldonk, 2018).

Technical approaches have been dominant in research and development, and successful improvement has to start from smallholder livelihood realities (Hailemichael, Gebremedhin and Tegegne, 2017). For poultry to continue making positive and sustainable contributions to stable human society, it is essential that production and marketing be tailored to local conditions and associated value chains, and that they maximize nutrient cycling and the efficient use of all products, maintain genetic diversity and are accompanied with improvements to local health services (Alders et al., 2019). The Small Livestock Advantage programme offers insights into the opportunities for poultry – chickens, geese, ducks, turkeys, guinea fowl, pigeons and quail – as well as for swine, small ruminants, guinea pigs and rabbits (IFAD, 2020). Building on case studies from Afghanistan, Lesotho, Nepal, Senegal and Venezuela, it concludes that small livestock contribute to:

Technical approaches have been dominant in research and development, and successful improvement has to start from smallholder livelihood realities.

- Mitigating negative impacts of the COVID-19 pandemic and improving food security, nutrition and livelihoods.
- Maintaining household food and nutrition security.
- Maintaining household economic security.
- Supporting opportunities for women's employment, especially related to livestock processing and rearing.

- Enabling climate change adaptation.

Establishing and sustaining effective livestock breeding programmes remains challenging in many countries, particularly in the low-input production systems of the developing world. But such programmes can sometimes give remarkable results that are relevant to livelihoods. Consider the relationship between tilapia breeding in Egypt and the food preferences of low-income consumers. Models predicted that younger women consumers with children in Lower Egypt were more likely to consume smaller tilapia sizes and prefer larger tilapia head traits. In this way, breeding programmes can be pro-poor and gender-responsive (Murphy et al., 2020).

Animal welfare receives less attention in lower-middle-income countries than in high-income countries, where animal rights are increasingly incorporated into legislation. Since prehistoric times, animals have been viewed as an integral part of human life – a source not only of livelihood but also of companionship. But in recent decades the debate on the use of animals in human society has been contentious, with the main focus on the benefits derived from them. McCrindle (1998) provided an overview of African perspectives on animal well-being set largely in a context of human poverty and malnutrition, where concern for animals exists but differs from the concerns of urban consumers in high-income countries.

Sustainability and resilience are at stake where food-feed competition and high GHG emissions predominate

The animal production sector uses most of the world's grasslands and more than a third of the world's arable land for feed production, while also driving heavy use of rainwater and irrigation water (World Bank, 2019; Oosting et al., 2021). Livestock use these resources mainly for feed production, with four broad impacts:

- **Conversion of forests and other natural vegetation to feed-crop land and pasture.** This results in loss of biodiversity, depletion of aquifers and GHG emissions, but also creates room for food and cash crops.
- **Competition with food crops for land and water.** Of the world's 2 billion hectares of grassland, one third could potentially be used as cropland. Feed production uses about a third of agricultural water. Livestock production is generally less efficient than crop production in terms of human food obtained per unit of arable land.
- **Land degradation.** Overgrazing affects vegetation cover and potentially results in productivity losses, soil erosion, carbon losses and adverse impacts on biodiversity and water cycles.
- **Pollution of water and land resources.** Pesticides, chemicals and other unwanted substances such as metals and organic residues end up in the ecosystem, affecting flora, fauna, fisheries, drinking water and tourism.

While animal production systems and ASF may cause major GHG emissions, their effects vary substantially by animal or food group, region and production system. Emissions from ASF production have been estimated to contribute 14.5 per cent of global anthropogenic GHG emissions (Duku et al., 2021). The largest contributor is methane (about 44 per cent in CO_2 equivalent), followed by nitrous oxide (29 per cent) and carbon dioxide (27 per cent). Emissions from ASF production account for 44 per cent of global anthropogenic methane, 53 per cent of global anthropogenic nitrous oxide and 5 per cent of global carbon dioxide emissions.

On both GHG emissions and land use per 100 grams of protein, beef, lamb and mutton rank convincingly at the top and fish, poultry, meat and eggs rank considerably lower (**TABLE 2.2**). Still, protein-rich food crops have smaller GHG emissions per 100 grams of protein (Poore and Nemecek, 2018). Contributing substantial GHG emissions, enteric fermentation from livestock production consists of methane gas produced in the digestive systems of ruminants and to a lesser extent non-ruminants (Duku et al., 2021).

TABLE 2.2 GREENHOUSE GAS EMISSIONS AND PRESSURE ON LAND ASSOCIATED WITH THE PRODUCTION OF PROTEIN-RICH FOODS

PROTEIN-RICH FOODS	GHG EMISSIONS (KG CO_2 EMITTED PER 100 G PROTEIN)		LAND USE (M^2/YEAR/100 G PROTEIN)	
	AVERAGE	10TH PERCENTILE	AVERAGE	10TH PERCENTILE
ANIMAL-SOURCED				
Beef	50.0	20.0	164.0	42.0
Lamb and mutton	20.0	12.0	185.0	30.0
Cheese	11.0	5.1	41.0	4.4
Pig meat	7.6	4.6	11.0	4.8
Fish (farmed)	6.0	2.5	3.7	0.4
Poultry meat	5.7	2.4	7.1	3.8
Eggs	4.2	2.6	5.7	4.0
PLANT-SOURCED				
Tofu	2.0	1.0	2.2	1.1
Groundnuts	1.2	0.6	3.5	1.8
Peas	0.4	0.3	3.4	1.2
Nuts	0.3	-2.2	7.9	2.7
Grains	2.7	1.0	4.6	1.7

Source: Poore and Nemecek, 2018.

Manure is another major source of GHG emissions. Of all food production processes, manure contributes the second highest GHG emission levels in all regions, with more than half from manure deposited on pastures (Gerber et al., 2013; Tubiello et al., 2013;). Forage can be combined with shelters and rotational grazing to restore pasture and reduce GHG emissions (**BOX 2.5**).

Major shifts to fish-based and vegetarian and vegan diets would be needed to eradicate animal-related GHGs, following the EAT-Lancet approach, which emphasizes the need for much greater consumption of plant-based foods and lower consumption of ASFs, particularly red meat (Poore and Nemecek, 2018). Some oppose the EAT-Lancet approach, claiming it is focused solely on the threat ASF consumption poses for sustainability and human health, ignoring variability in the environmental impact of livestock production and failing to adequately include the experience of marginalized women and children in low- and middle-income countries whose diets regularly lack the necessary nutrients (Adesogan et al., 2020).

How do animal production systems and ASF fit into a circular food system?

Moving from linear to circular systems has been advocated as part of a food system transformation that is healthy, inclusive, and environmentally sustainable and resilient (CHAPTER 7). For animal production systems and ASF, the contribution of specific farmed animal groups to circular food systems can be assessed against four criteria:

BOX 2.5 LIVESTOCK AND PASTURE DEVELOPMENT IN TAJIKISTAN

Khatlon is the poorest region of Tajikistan, with 78 per cent of the population below the national poverty line and livestock one of the main sources of income. Decades of overgrazing to meet rising demand for animal feeding has deteriorated pastoral land. Fodder, veterinary services and other livestock support services can, therefore, contribute to increasing meat and milk production.

An IFAD project that ran from 2011 to 2017 addressed nutritional deficiencies in Khatlon and contributed to livestock production and productivity increases while addressing climate change adaptation and mitigation needs. It did this through pasture-user unions, farm equipment and seed upgrades, and the construction of water points and sheds for livestock, combined with guidance on breeding techniques and veterinary services.

Livestock production increased dramatically, benefiting more than 23,000 households. The number of livestock owned increased by 60 per cent, sheep and cattle weight increased by 17 per cent and 27 per cent, respectively, and livestock income per year increased by 42 per cent. Reducing the cost of water and increasing access to water was crucial in implementing the project.

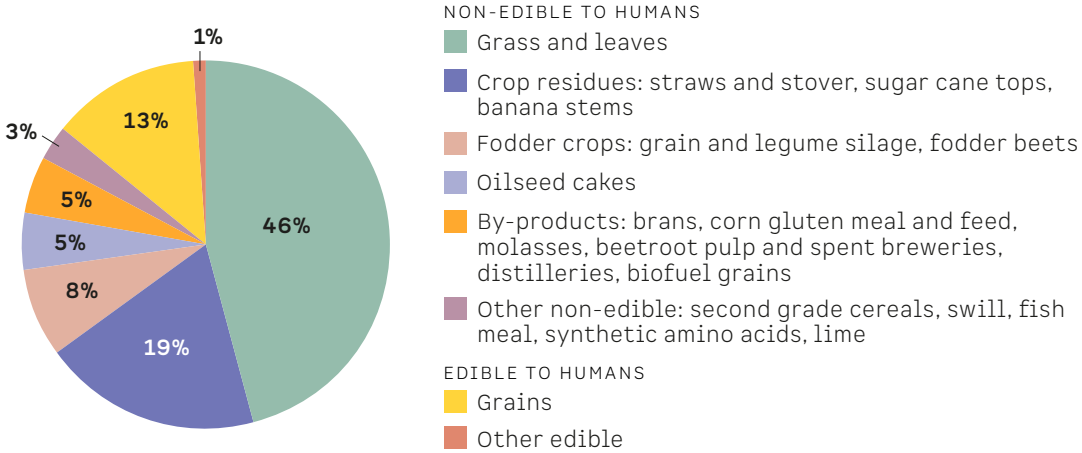
Source: IFAD, Livestock and Pasture Development Project, Tajikistan impact assessment technical report and project completion report.

- Does the ASF production system use arable land and water bodies primarily to produce food for direct human consumption?
- Does it avoid or minimize food losses and waste?
- Does it recycle inevitable food losses, waste streams and by-products (such as crop residues, processing co-products, manure and excreta)?
- Does it use animals for unlocking biomass – with low-opportunity cost to humans – into high-value food, manure and other ecosystem services?

Only about 14 per cent of feed dry matter ingested by livestock is edible for human beings – and the share is likely to be even lower in some developing countries, where ruminant livestock subsists mainly on pastures or crop residues (**FIGURE 2.3**). The land to produce that 14 per cent, however, includes land that could be used to grow food crops.

How much circularity is achievable and desirable, and how many animals should be part of it? "Optimal" animal populations would allow protein consumption from ASF to be maintained at up to 7-36 grams per capita per day – with the restrictive boundary condition that livestock and fish would consume only feed from waste streams and from land (and water bodies) unsuitable for human food crop production (Van Kernebeek et al., 2014; Van Zanten, Van Ittersum and De Boer, 2019; van Hal, 2020). This condition rules out using land for pastures and feed crops that could also be used for food crops.

FIGURE 2.3 GLOBAL LIVESTOCK FEED DRY-MATTER INTAKE FROM DIFFERENT SOURCES



Source: Adapted from Mottet et al. (2017).

Farmed animal production systems should be assessed for their degree of and potential for circularity

Smallholder farmers generally manage animal production systems that are already largely circular and non-detrimental, requiring few external inputs. The animals feed on crop residues and on land that is either not suitable for other purposes or where crops have already been grown and residues have been left in the field to feed animals. When animal production intensifies, with feed from outside the system, circularity needs to be managed better. For example, integrated farming systems depending on animal traction face challenges when herd sizes become too large.

In South-East Asia and sub-Saharan Africa, farmed animals play important roles in circularity. Because feed inputs and fertilizers are scarce, most farming systems use crop residues, agro-industrial by-products and manure as inputs. Three systems are relevant for their degree of circularity: pastoralist herding, fish farming and dairy farming.

Traditional pastoralist herding systems are found in regions where human food crop production is biophysically impossible. Such systems do not directly compete for land use with human food crop production. They also avoid food waste by exploiting dryland grazing areas and the biomass growing there. If not grazed, the biomass will turn dry and will not be used. Pastoralists can draw on extensive traditional ecological knowledge to align their land and water use with natural dynamics in these regions. Waste recycling occurs as herds manure the croplands while they graze crop residues in the dry season. Pastoralist systems use animals for what they are good at: turning low-opportunity cost biomass into valuable food. Yet present-day expansion of sedentary agriculture puts pressure on the sustainability of pastoralist systems (Rao et al., 2021).

Fish farming in ponds does not compete with human food crop production directly – but it can do so indirectly. In South-East Asia, inland and coastal ponds are the major fish-farming systems, contributing more than 75 per cent to global fish and shrimp production (FAO, 2020b). Many ponds are fertilized with leftovers, manure and kitchen waste. For example, the semi-intensified systems in Bangladesh (Belton and Azad, 2012) produce fish with a combination of organic fertilizer, kitchen waste, home-made feed from local agricultural by-products and commercial feed (Mamun-Ur-Rashid et al., 2013; Jahan et al., 2015; Henriksson et al., 2018). Commercial feed produced in Bangladesh accounts for 2 million metric tons (Mamun-Ur-Rashid et al., 2013), and 90 per cent of the ingredients are by-products from other agricultural activities (Mamun-Ur-Rashid et al., 2013; Kabir et al, 2017). Some of the production models from Asia have been piloted in several African countries. A pilot rice-aquaculture model in the inland valley swamps of Sierra Leone enhanced the circular use of agricultural waste and by-products: thanks to this approach, fish was produced as an additional source of animal protein, increasing profitability (Sankoh et al., 2018; **BOX 2.6**).

BOX 2.6 FISH FARMING IN SIERRA LEONE TO IMPROVE FOOD AND NUTRITION SECURITY

Communities in the district of Tonkolili in northern Sierra Leone face high levels of child stunting due to food insecurity and malnutrition. Income-generating activities in the district are limited, aggravated by the decline in mining activities in the area. Since 2015, the Feed the Future project, funded by the United States Agency for International Development, has implemented new aquaculture practices in Tonkolili to boost farmed fish production and increase food and nutrition security as well as livelihood opportunities. Farmers are constructing their own ponds for tilapia production, providing nutrition-rich food for home consumption and generating a steady source of income by marketing the fish in the area. As part of the project, youth were involved in training on the role of nutrition in healthy diets.

FISH FARMER IN TONKOLILI DISTRICT, NORTHERN SIERRA LEONE

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Source: Regional consultations.

Dairy farming takes place in a peri-urban context – mostly on small-scale dairy farms with limited land for fodder production and a high livestock density – and can contribute to circular systems in the right circumstances. In Indonesia, 98 per cent of all dairy cattle are concentrated on the island of Java (home to more than half of Indonesia's human population) in a circular food system, mainly using feed and fodder as inputs and manure as outputs (**BOX 2.7**).

BOX 2.7 DAIRY FARMING AND CIRCULAR FOOD SYSTEMS IN INDONESIA

In the Indonesian subdistrict of Lembang, circularity reduces food-feed competition in dairy farming. The major part of the feed ration of dairy cows consists of by-products (de Vries et al., 2019). About 55 per cent comes from agro-industrial by-products – mainly tofu waste, cassava pomace and ingredients of compound concentrate feed (such as imported wheat pollard, palm oil meal and corn gluten feed). Another 15 per cent or so comes from crop residues (mainly rice straw).

Not everything about Lembang's dairy farm sector is so circular, however. Most of Lembang's dairy farmers (84 per cent) dispose of at least part of their herds' manure in the environment. Only a limited amount is used for fertilizer, mainly because dairy farmers have too little land to fertilize – and because their land is often far away from the cow barn. And when manure is applied to nearby cow barns, the amounts are extremely high, resulting in high run-off and leaching (de Vries and Wouters, 2017).

Most farmers acknowledge that manure disposal is a problem. Practical and economic barriers to the utilization of manure include the lack of land and the costs and labour required for handling and transportation. In addition, cattle manure has a relatively low nutrient content compared with synthetic fertilizer, which is heavily subsidized for small-scale farmers in Indonesia, making organic manures less competitive in terms of macronutrients (Warr and Yusuf, 2014).

Source: Oosting et al., 2021.

Circular innovations in novel protein development

Novel protein sources such as insects and micro- and macroalgae can contribute to future foods (Parodi et al., 2019). Their production could be based on recycling waste streams, with limited land use, and low GHG emissions and nitrogen and phosphorus pollution. Consuming insects and algae as human food is a novelty in some parts of the world, but it is already common in diets in many parts of the world. To reduce feed-food competition resulting from intensified animal systems, novel protein sources could replace traditional protein sources such as soybean meal and fish meal in concentrate feeds. Food safety regulations in many countries do not authorize the consumption of insects as human food (in the European Union, for instance) but include a recommendation for accelerating policies and regulations.

Producing insect protein for feed holds promise for circular food systems. Insects can convert waste – from many sources – into food and feed. They require limited water, nutrients, space and energy, and the GHG emissions associated with their production are low (van Huis and Oonincx, 2017; Parodi et al., 2019 (**BOX 2.8**)).

The production of insects using waste streams as a feed protein source can substantially reduce the use of farmland to produce feed ingredients, mainly proteins (Mulia and Doi, 2019). In Kenya, if insects supplied the 160,000 tons of protein needed annually for concentrate, about 200,000 hectares of land could be shifted from soybean production for feed to human food production.

Substituting novel proteins can also reduce pressure on fish stocks in food systems that now use fishmeal in concentrate feeds. Aquaculture is the fastest-growing food sector, expected to contribute substantially to meeting the ASF protein requirements of a growing world population. To prevent competition for the same limited land and water, conventional protein ingredients can be replaced with microalgae, macroalgae (seaweed), yeast and bacterial biomass (microbial protein) (**BOX 2.9**).

BOX 2.8 INSECT PROTEINS PRODUCED FOR FEED AND FOOD IN EAST AFRICA

Human consumption of insects is common in Uganda. Edible insects are highly in demand in markets, and the prices are higher than those of beef, pork and poultry (Odongo et al., 2018). Insect marketing in Uganda is built on extensive supply chain networks of collectors and traders.

Insects have traditionally been eaten in northwest Tanzania, around Lake Victoria, where the local population appreciate the longhorn grasshopper *Ruspolia differens* as a delicacy (Mmari et al., 2017).

In western Kenya, people eat termites and other insects. Farming insects can be important for the livelihoods of smallholders, because it can increase household food supply, generate cash incomes and create employment opportunities for poor people (Kelemu et al., 2015; Ayieko, Ogola and Ayieko, 2016; Halloran et al., 2016).

BOX 2.9 ALTERNATIVE SOURCES OF PROTEINS AS FISHMEAL AND OTHER USES

Microalgae are microscopic algae found in the water column and sediments of freshwater and marine environments. They are at the base of the aquatic food chain, are responsible for half of the world's primary production and support the supply of 90 million metric tons of seafood per year through capture fisheries (Muller-Feuga, 2000; FAO, 2020b). If large-scale production of microalgae at an affordable cost becomes possible, microalgae could be a replacement for fishmeal and fish oil.

Macroalgae (seaweed) have a protein content of 5-50 per cent (Wan et al., 2019), can replace fishmeal in fish diets and are rich in highly unsaturated fatty acids. They are a popular human food in South-East Asia, and because no external nutrient inputs are needed, they could reduce GHG emissions by replacing terrestrial plant sources otherwise used in fish feeds.

Yeasts are co-products from the brewing industry. They contain 45-55 per cent crude protein and can replace fishmeal up to 75 per cent in fish diets without compromising growth (Pongpet, Ponchunchoovong and Payooha, 2015; Gamboa-Delgado et al., 2016).

Bacterial biomass is a popular alternative protein source not competing with human food. It can be grown using agricultural waste such as fruit pulp and corn stover effluents (Mahan et al., 2018), and even manure (Patthawaro and Saejung, 2019).

Simulation 2 in annex 1 illustrates how doubling the productivity of feed for livestock and aquaculture, against a business-as-usual baseline, increases the affordability of food but increases wages gaps for the lowest skilled.

Policy priorities for animal production and ASF

At the global level, concerns about increasing ASF intake and overconsumption – and about resulting negative impacts on health and sustainability – need to be communicated in a more precise way. The concerns are valid, but:

- ASF intake differs greatly across regions.
- Animals eat many products that are not edible for humans, including wastes that would otherwise be a nuisance.
- Animal food groups differ largely in their ability to move from linear to circular production systems.
- Animal proteins are important food intake in countries where there is underconsumption.

Game-changing yet realistic solutions are needed to drive the transition towards healthy and sustainable consumption patterns in a culturally appropriate manner. Support should be given to the promotion of sustainable smallholder livestock production systems in low- and middle-income countries.

- Protocols and simple input-output models should be developed that can easily map animal and ASF production systems in terms of their degree of circularity. Such models can inform accounts of pathways towards more circular food systems.
- Mechanisms should be put in place that create incentives for markets and corporations to provide ASF for healthy and sustainable diets. Such mechanisms can be based on national dietary guidelines.

Investments are needed in educating the younger generation on healthy diets, with unbiased information for consumers. Awareness-raising should focus on both the pros and the cons of consuming ASF in various quantities.

Novel protein development can be taken to scale through public-private investments. The potential is obvious, but it needs to gain momentum. Novel protein production can add greatly to traditional animal-derived proteins at a low environmental cost.

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PART B

Food production

Chapter 3 on food production structures and dynamics considers how to integrate smallholders into efficient larger value chains and to diversify and improve small-scale agriculture through knowledge-based, sustainable production methods that produce more diverse and nutrient-dense foods. Shifting agriculture towards producing more nutrient-dense foods will require more diversified production systems, with markets to support them.

Agriculture's main challenge for the coming decades is to produce enough healthy and affordable food for a growing global population at an acceptable environmental cost. Meeting this challenge will require a shift from producing calories to producing nutrient-dense foods and making diverse and nutritious foods more available and affordable. Policymakers and other food system stakeholders should create opportunities for smallholder farmers to diversify, both for income and for improved on-farm food supplies. They should enhance a transformation towards sustainable production based on principles of circularity to move away from maximizing agricultural output to optimizing natural resource use. And they should inform this shift in production with an R&D agenda that focuses on providing evidence and advice – and support a major expansion of public and private agricultural extension services to accelerate the use of digital technologies by smallholders.

Chapter 4 delves into how climate change, the environmental footprint and food loss and waste can be tackled through circular systems. It explores two broad strategies for making food system resource use more sustainable and efficient. One is training farmers, traders and households in better resource management practices. The other is improving resource use technologies. Both strategies aim to gradually decouple growth from the use of finite resources, arriving at a circular economy that is regenerative by design and uses intensive feedbacks among food system components to recycle and reduce material losses. To transform food systems in a more circular direction, policymakers should support efforts to come up with new technical opportunities and provide financial incentives to encourage adaptive behaviour.

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CHAPTER 3
Transforming food production systems for rural people's well-being

Agriculture, beyond being a food producer, is a key source of income and employment for the world's rural poor – and with proper management it can sustain natural resources. A desirable food system transformation must include a concerted focus on small-scale agricultural production, including crops, livestock, fish and forest production. The objective must be not simply to integrate smallholders into efficient larger value chains, but also to diversify and improve small-scale production with knowledge-based and circular sustainable production methods, geared towards producing diverse and nutrient-dense foods. These shifts must be complemented with expanding the off-farm livelihood opportunities for rural people.

Efforts to leave no one behind and to meet the Sustainable Development Goals (SDGs) – particularly SDG 1 (Poverty) and SDG 2 (Hunger) – will hinge on the world's success in harnessing food systems for rural people's well-being (FAO, 2017). Such a transformation is essential not only to feed the world well and sustainably, but also to eradicate poverty and hunger while tackling the climate crisis. Agricultural production is both a major contributor to greenhouse gas (GHG) emissions and highly vulnerable to its effects, particularly in low-income countries. It is a primary driver of biodiversity loss. It continues to overuse freshwater for agriculture and degrade soils. And when mismanaged it drives down the productive capacity of land (Dasgupta, 2021).

An estimated 500 million small-scale farms are in low- and middle-income countries. These households account for as many as 3 billion people globally, more than a third of the human population (Woodhill et al., 2020). These small-scale farms produce much of the food consumed in low- and middle-income countries – but they also constitute the majority of people who live in extreme poverty and suffer hunger (Woodhill et al., 2020). And they are also among the groups most vulnerable to climate change. The challenge is thus to enable rural people to produce nutritious and healthy foods, while containing agriculture's environmental footprint and realizing the value of ecosystem

services in production – all while expanding decent livelihood opportunities for poor and marginalized people.

This chapter develops four messages:

1. **Agriculture needs to shift towards producing more nutrient-dense foods – a shift that will require more diversified production systems, with markets to support them.** This can be achieved by policy actions informed by a better understanding of production requirements and economic viability for a portfolio of products based on agroecological conditions and marketing opportunities.

2. **Shifting to more knowledge-based, adaptive and sustainable production systems – and moving away from a narrow focus on maximizing cereal production – can overcome the negative environmental and nutritional impacts of current agricultural systems.** Through knowledge-intensive agriculture, farmers should be able to have access to, and make decisions on the basis of, multiple and timely sources of knowledge and information on market conditions, agroecology and climate-related risks. That will foster productivity gains through sustainable production systems and greater resilience to climate change and the other shocks and stresses that threaten food and nutrition security.

3. **Many small-scale agricultural producers need diversified incomes for decent and resilient livelihoods, since relatively few will be able to achieve this through farming alone.** Improving agricultural production systems requires narrowing the yield gaps[5] for greater agricultural productivity and enabling smallholders to diversify production into high-value and diversified crops. But such an approach cannot work for all of them because of the constraints of quality standards, capital requirements and market arrangements. So diversifying beyond farming by developing off-farm opportunities becomes critical.

4. **Transforming agricultural production must be inclusive and equitable, focused on opportunities for women, youth and indigenous people.** Production of nutrient-dense foods through sustainable intensification does not necessarily lead to inclusive food systems. So special efforts will be needed to ensure that the needs of women, youth and indigenous people are accounted for in the development of strategies and investments.

Following these four sections, a final section translates these messages into policy priorities for transforming agricultural systems in ways that will be inclusive and support the rural poor.

[5] Yield gaps are the difference between potential (Yp – irrigated conditions) or water-limited potential yields (Yw – rainfed conditions) and actual farmers' yields – Ya (van Ittersum et al., 2013).

Agriculture to shift towards more nutrient-dense foods through diversified production systems and market support

Agriculture's main challenge for the coming decades is to produce enough healthy and affordable food for a growing global population at an acceptable environmental cost. Meeting this challenge will require a shift from producing calories to producing nutrient-dense foods and making diverse and nutritious foods more available and affordable.

Higher diversity in diets is associated with better health outcomes (Brouwer et al., 2021). For low-income countries, the diversity of agricultural goods produced by a country is a good indicator of the diversity of the food supply – and higher levels of such diversity are associated with lower national stunting, wasting and underweight among children (Remans et al., 2014).

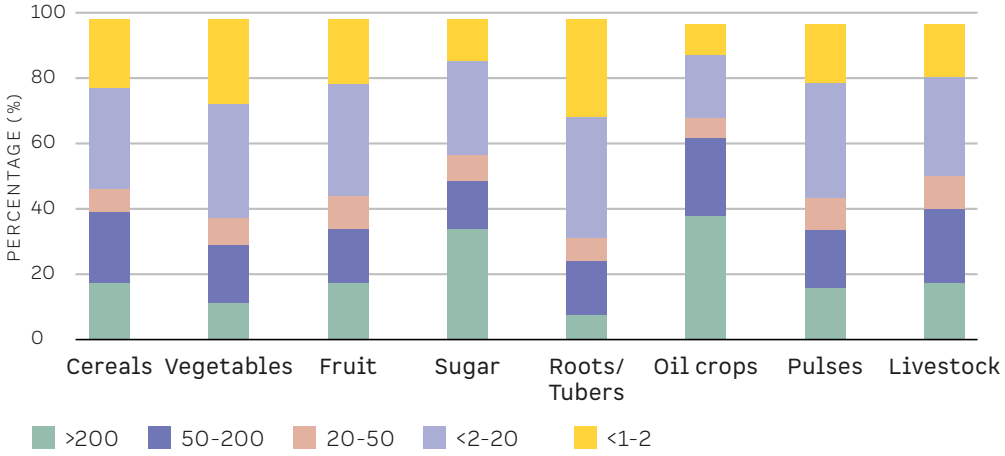
Since 1960, however, the global diversity of national food supplies has been declining: major cereals and oil crops have become increasingly dominant (Herrero et al., 2017). While more than 6,000 plant species have been cultivated for food, fewer than 200 make substantial contributions to global food output – and just nine accounted for 66 per cent of total crop production in 2014. Evidence suggests that the diversity present in farmers' fields has declined overall, and that the threats to diversity are getting stronger (FAO, 2019).

Small-scale farmers produce a large share (61 per cent) of global fruits and vegetables and a dominant share (67 per cent) of the roots and tubers. In contrast, medium-sized and large farms dominate in sugar and oil crops. Smallholders with less than two hectares produce 30-34 per cent of the global food supply on 24 per cent of global cropland area (Ricciardi et al., 2018). Across 83 countries, 44 million small farms in Africa and 338 million in Asia are responsible for 41 per cent of total global calorie production and for 53 per cent of the global production of food calories for human consumption (Samberg et al., 2016).

Globally, small and medium-sized farms (less than 50 hectares) produce 51-77 per cent of nearly all commodities and nutrients (Herrero et al., 2017). Many farms are very small (less than 2 hectares) and have local significance in sub-Saharan Africa, South-East Asia and South Asia, where they contribute about 30 per cent of agricultural commodities.

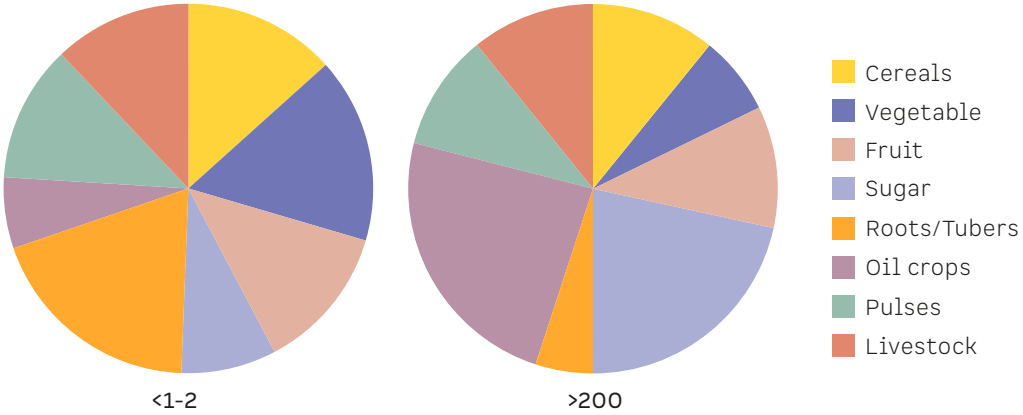
FIGURE 3.1 DISTRIBUTION OF FOODS PRODUCED BY FARM SIZE (IN HECTARES)

PER CENT OF TOTAL GLOBAL PRODUCTION



Source: Woodhill et al., 2021.

FIGURE 3.2 DIVERSITY OF FOODS PRODUCED: COMPARISON OF LARGEST AND SMALLEST FARM SIZES



Source: Based on Woodhill et al., 2021.

Agricultural intensification and increasing farm size are reducing the diversity of food production (**FIGURE 3.2**). Nutrient-rich species that are suitable for smaller plots, such as vegetables, fruits, and some roots and tubers, are reduced – while species that can be easily produced with mechanized systems, such as cereals, sugar and oil crops, are maintained (Herrero et al., 2017). This raises the risk of losing important nutrient diversity in the food supply system unless specific measures are taken to ensure it is conserved. Similarly disappearing at an alarming rate are nutrient-rich neglected and underutilized plant species, which could provide high nutrient potential if science and policy were better connected and if more coordinated policies and regulations pushed for their production and use (**BOX 3.1**).

BOX 3.1 NEGLECTED AND UNDERUTILIZED PLANTS – DISAPPEARING FAST

Nutrient-rich neglected and underutilized plant species (NUS) are crops, plants and species neglected or ignored by agricultural researchers, plant breeders and policymakers. They are generally not traded as commodities. They can be wild or semi-domesticated varieties and non-timber forest species creolized or adapted to specific, local contexts. These species, together with the knowledge about their cultivation and use, are being lost at a very alarming rate (Padulosi et al., 2013).

Many of them hold good potential for improving diets and nutrition, while protecting biodiversity and food systems (Bioversity International, 2017; Fanzo, 2019). There is uncertainly around the exact number of them that we can rely on to support biodiversity-enhancing and nutritious food production systems, going from a conservative estimate of 5,538 by the Royal Botanic Gardens, Kew (2016) to 12,500 reported in Kunkel's checklist of edible species (1984) and up to 75,000 in Wilson (1988) (in Hunter et al., 2019).

In the report on the *State of the World's Biodiversity for Food and Agriculture* (FAO, 2019), 15 of the 91 reporting countries (16 per cent) reported on the regular use of wild foods in their national diets. A recent review and research by Hunter et al. (2019) confirm their great potential for food and nutrition security, as well as the possibility of combating the "hidden hunger" caused by micronutrient deficiencies (Padulosi, 2013; Kobori and Rodriguez-Amaya, 2008; Bharucha and Pretty, 2010).

Since the Second World War, and especially in recent decades, the overarching rationale of agricultural and food trade policy has been that trade – by making agriculture more productive and its markets more efficient – will drive down food prices and drive up food availability and choice (CHAPTER 5). This expansion of food supply indeed contributed to reducing food insecurity (Pingali, 2012), and global food security increased thanks to cheaper and more widely available food (Benton and Bailey, 2019). But, as policies focused on increasing agricultural yields and crop efficiency, their negative unintended consequences have spilled over into the environment and health. Efficiency has come at the cost of quality. The scale of total food system costs is becoming clear only now, as the data revolution enables more transparent and more comprehensive analyses of the local and global impacts from the drive for cheaper calories.

Today, global agriculture is more productive than ever. Since the 1960s, global agricultural output has almost doubled (Alexandratos and Bruinsma, 2012). While the global population rose by 142 per cent between 1961 and 2016, average cereal yields increased by 193 per cent and calorie production by 217 per cent (Benton and Bailey, 2019). Yet at the heart of this remarkable achievement lies a paradox: as the efficiency of production increased, the capacity of the food system as a whole – to deliver nutritious food sustainably and with little waste – declined. Yield growth and falling food prices have been accompanied by increasing food waste, a growing malnutrition and obesity burden, and unsustainable environmental degradation. A recent study on the environmental impacts of food systems reports that failure to apply mitigation approaches in agricultural production would lead to a 50-90 per cent increase in global environmental pressures and a destabilization of key ecosystem processes (Springmann et al., 2018). These externalities

and unwanted food system outcomes have emerged and increased over time as consequences of unbalanced food system governance, supporting the need for a transformed food system that moves from producing more food towards finding ways "to nourish everyone in ways that can be sustained environmentally, economically and culturally" (Haddad et al., 2016: 32).

Diversification of agricultural systems is a prominent means of enhancing resilience, since different crops and livestock production systems have varied levels and types of vulnerability. Diversifying the vulnerability of production systems reduces the risk of total production loss. Such resilience can be defined as the system's capacity to manage and respond to challenges, both foreseeable trends and unexpected events, while maintaining its essential functions of providing private and public goods. Robustness, adaptability and transformability are key to farming system resilience – and each of these three elements is positively affected when farming practices become more diverse (**BOX 3.2**).

The need to reinforce the resilience of farming systems has also been highlighted by the current COVID-19 pandemic. Although responses have varied greatly between farming systems, many have been affected, and vulnerabilities have been exposed. These range from farmers facing agricultural input shortages because of logistical restrictions, through limitations in market access because of restrictions in human mobility, to losing employment and income from remittances. But the effects have been limited as a result of the widely acknowledged need to keep food supply chains and trade functioning.

The real impact of COVID-19 on the rural poor and small-scale farmers is not yet clear, but there is an emerging consensus that there will be an increase in food insecurity, mostly through impacts on loss of income and employment among poor people (Béné et al., 2021). The crisis has also showed the disproportionate risk faced by small-scale producers, who have limited assets and savings to cope with disruptions to incomes and who, on average, are net purchasers of food. Higher food prices hit them as purchasers but do not flow back to them to any significant degree as sellers (Woodhill, 2020).

BOX 3.2 DIVERSIFICATION CAN CONTRIBUTE TO HEALTHIER DIETS AND FOOD SYSTEM RESILIENCE

A key topic brought to the fore in our regional consultations among food system experts across IFAD regions is the role of agricultural diversification in creating healthier diets and improving food system resilience. Experts stress the need to invest more knowledge and resources in nutritious foods beyond cereals. One from the Latin America and the Caribbean region put it thus:

"The main crops, maize and rice, have had a lot of investments, and so there's been a lot of production. Many of the diets across the region are based on maize and rice, and wheat to a lesser extent. So a lot of investment has been put on those, and not so much on the more nutritious foods: fruits, vegetables, other kinds of small livestock."

Source: Regional consultations.

A shift towards producing more nutrient-dense foods and reducing the yield gaps requires analysis of production requirements and opportunities for an expanded portfolio of agricultural products based on agroecological conditions as well as market opportunities. A main reason for smallholder farming systems to be dominated by staple crop production – even when farms produce a surplus – is that markets always exist for staple crops, even if they are not especially profitable. The highly perishable nature of many fruits and vegetables calls for more intensive post-harvest management and, in some cases, cold storage. Post-harvest infrastructure needs and local agroecological conditions are key determinants of feasible and profitable diversification into nutrient-dense foods.

Adaptive, knowledge-based and sustainable agriculture

Maximizing food production can no longer be the exclusive focus of policies – what is needed is a more adaptive, knowledge-based, sustainable agriculture, fostering resilience to climate change and other shocks and stresses that affect food and nutrition security. Historically, increasing agricultural productivity has had significant negative impacts on ecosystems and the services they provide to farmers and broader communities (Tilman, 1999; Foley et al., 2005, 2011; Lipper et al., 2020). Agriculture now needs to shift from production systems that deplete and degrade natural resources to ones that utilize ecosystem services to enhance resource use efficiency in production – while also enhancing the systems' resilience. This implies a shift from monocropping to more integrated production systems, and from agricultural systems reliant on indiscriminately high external input use to ones that are knowledge-intensive.

Knowledge-based agriculture

Knowledge-intensive agriculture has many interpretations and synonyms, such as "smart agriculture", "e-agriculture", "precision agriculture" and "data-driven agriculture". What these connotations have in common is that farmers have access to and make use of multiple sources of knowledge and information on agroecological and market conditions in their decision-making on important aspects of their farm operations. These sources include traditional knowledge developed over and transferred by generations but also scientific knowledge and data-driven information. Information and communication technologies (ICTs) can facilitate an information- and knowledge-based approach and be possible game changers in a radical transformation of food and agricultural production systems. In a nutshell, the options would include:

- Advisory and information services, such as relevant agronomic, environmental data to smallholder farmers: early warning weather, agro-advisory.
- Market linkages, such as price information.

- Supply chain management, such as market access and traceability by better connecting buyers, sellers and producers, for example through digital marketplaces and end-to-end supply chain management solutions.
- Financial services.
- Macroagricultural intelligence.
- Bundled solutions use case (Ceccarelli et al., 2021).

As a result, agriculture becomes more networked, with a variety of information sources and decision-making to achieve more efficient resource use. But there are obstacles to ensuring that digital technologies can support the food system transformation towards desirable pathways, starting first with the connectivity, diffusion and infrastructure required. For example, although mobile penetration and network connectivity are high in all countries, the adoption of internet and more sophisticated technologies has lagged in developing and least-developed countries.

To avoid information imbalances with buyers, smallholders need their own information networks, implying that more traditional connections will operate in parallel with more modern technologies for some years to come. Although COVID-19 has pushed forward an ICT revolution and digitalization of agriculture and food markets, there is still considerable need to build an enabling governance and regulatory environment as well as the infrastructure and institutions (IFAD, 2019; Ceccarelli, 2020). Communities in low- and middle-income countries will continue to rely on traditional means of communication delivery and telecommunications infrastructure (the limited network of landline telephone connections, radio, emails, simple feature phones) for a number of years. So multiple delivery channels and platforms will have to coexist. And strategies combining traditional and advanced delivery channels as well as intermediaries with mobile-based solutions on the ground (extension services, loan officers, street-level agents) will still be needed in view of the slow penetration of broadband connectivity and related services.

Sustainable agriculture

In addition to a knowledge transformation, agriculture requires a sustainability transformation to make production more efficient and tailored to the agroecological context and a changing climate. As food production inevitably increases, it must do so without expanding agricultural lands, implying that existing agricultural lands need to be farmed more efficiently (**BOX 3.3**). The best places to improve crop yields may be on underperforming landscapes, where yields are well below their potential. In other words, increasing production could focus on food systems where yield gaps are greatest.

BOX 3.3 MORE SUSTAINABLE PRODUCTION TO GUARANTEE THE FUTURE OF FARMING

Many food system experts consulted for this report indicated the need to move to more sustainable forms of production – to protect the environment and prevent degradation of key resources. As one government official put it: "The intensification generates money, but generates a lot of sustainability problems. This way, it is not possible to continue. The soybean sector, livestock, rice sector, they are all very intensive and generate problems with methane, with soil erosion, water contamination. Now the trade-off is: perhaps we need to obtain less money, but in a more sustainable way. We need to implement a more sustainable agrifood system."

Source: Regional consultations.

Sustainable intensification is one approach to address this need. In essence, it is a production process or system that increases yields without adverse environmental impact or the cultivation of more land. What this concept means in practice is much debated. Sustainable intensification is about not just reducing environmental damage while increasing productivity, but also about taking sustainable principles as a point of departure for productivity enhancements. In this view, sustainable intensification implies using ecosystem services to enhance productivity (Rockström et al., 2017). Note that sustainable intensification does not explicitly address equity and food access – focusing instead on environmental sustainability in production.

The transition to sustainable intensification in agriculture is a knowledge-intensive process that should not be perceived as simply the promotion of traditional or low-input practices. Sustainable resource management requires knowledge about the ecological functions of agroecosystems and their relation to management and agronomic practices. Best practices vary for different microclimates and for households with different resources.

A key feature of sustainable intensification is increasing input use efficiencies, which can be grouped under three main types: those related to resources (underuse of inputs), technology (type of technology used), and efficiency (inefficient use of inputs – including overuse) (Giller, 2021). Closing efficiency and resource yield gaps by improving the timing and amount of inputs applied for cereals on currently cultivated land in Ethiopia could deliver the added production needed to achieve national self-sufficiency and reduce cereal import dependency by 2050 (Assefa et al., 2020; van Dijk et al., 2020; Silva et al., 2021). Half of the technology yield gaps in Ethiopia are explained by suboptimal seed and fertilizer application rates in the highest-yielding fields, pointing to farmers' economic and capital constraints (Assefa et al., 2020; Silva et al., 2021). These insights are also relevant to other parts of East Africa (Tittonell and Giller, 2013).

Sustainable agricultural intensification also involves more efficient management of water. In rainfed systems, which account for 95 per cent of farmland in sub-Saharan Africa, better management of rainwater and soil moisture is the key to raising productivity and reducing yield losses during dry

spells and periods of variable rainfall. Supplemental irrigation – using water harvesting or shallow groundwater resources – is underused for increasing water productivity in rainfed agriculture (HLPE, 2015; Oweis, 2014).

Increased organic and inorganic fertilizer use of appropriate quantity and timing is crucial for sustainable intensification in areas of currently low productivity. It raises food output per hectare and therefore relieves the pace of converting natural habitats to cropland (van Ittersum et al., 2016). And it augments the production of biomass and other sources of organic matter that can improve soil quality. But it must be part of integrated soil fertility management, which includes the use of quality seeds and timely planting. And to make investments in farm inputs profitable to producers, market information is needed to support decisions about the allocation of these inputs.

Small-scale agricultural producers are constrained in adopting sustainable intensification techniques (Arslan et al., 2020). Many practices require up-front investments of capital inputs and substantial labour, while the benefits may not materialize until several years after the practices are adopted. Other key constraints include a lack of access to land, water rights, finance, information and new technologies – all constraints that tend to be greater for women, limiting their productivity. While better-resourced farmers may be willing to make such investments, poor farmers tend to prioritize immediate food security needs and face serious labour constraints, since they depend on wage labour for their income. Women farmers in particular cannot adopt practices that demand labour and involve long-term investments (Jayne et al., 2019). Weak land tenure security also impedes the adoption of integrated soil fertility management, especially for women.

One example of a project to help smallholder farmers overcome these constraints is described in **BOX 3.4**.

BOX 3.4 INCREASING INCOMES AND FOOD SECURITY IN MADAGASCAR

Most of Madagascar's population lives in rural areas (78 per cent), and a dry climate troubles smallholder farmers. Investments in irrigation are required to support farming activities and ensure efficient land use.

To improve incomes and food security among smallholder farmers in the Menabe and Melaky regions, the project built upon instruments of rural infrastructure development to primarily benefit rice producers through secure land tenure and infrastructure development.

The estimated total number of beneficiaries is 156,000, or 26,000 households. Water user associations were established to ensure sustainable use of irrigation infrastructure, with a total of 34 being set up or strengthened through the course of the project. Irrigation allowed two and in some cases even three production cycles a year. Annual rice yields increased by 27 per cent and the value of crop production per hectare increased by 24 per cent. Durable assets and food security also increased because of the higher incomes. The project continues to build the capacities of water user associations through financial and educational support.

Source: IFAD project completion reports and impact assessments.

Adapting to climate change also drives the adoption of agricultural techniques that enhance resilience as well as productivity. Maintaining ecosystem services that regulate soil and water quality – while also supporting resistance to disease and pests – plays a key role in adaptation.

Agroforestry, which involves growing woody perennials in association with food crops and pasture, is a climate-smart agricultural practice: it contributes to climate change mitigation and adaptation, as well as to food security. Across the Sahel and at the southern edge of the Sahara, farmer-managed natural regeneration programmes based on agroforestry have bolstered farmer resilience to climate change, boosted their productivity and increased CO_2 sequestration and storage. A review of agroforestry's impact on crop yields (Kuyah et al., 2019) shows that agroforestry increases yields in both humid and semi-arid conditions. The most effective agroforestry practices are alley cropping, biomass transfer and planted fallows.

Significant barriers stand in the way of smallholder adoption of agroforestry practices. In Africa, the most prominent barrier to agroforestry adoption was a lack of access to information, chiefly from extension services. Also needed was targeting those with lower endowments, especially women farmers and woman-headed households (Arslan et al., 2016).

An alternative and much broader approach to sustainable agriculture is agroecology, which embraces science, a set of practices and a social movement. It has expanded from a focus on fields and farm practices to encompass entire agriculture and food systems (HLPE, 2019). It aims to build resilient farming and food systems that are inclusive of small-scale producers and low-income consumers, provide a diversity of safe and healthy food, and regenerate and improve biodiversity and ecosystem services. It is based on applying ecological concepts and principles to optimize interactions between plants, animals, humans and the environment, while considering the social aspects of a sustainable and fair food system. Its three core elements are recycling; resource use efficiency; and integration of a diversity of different crops and/or animals into a system. Agroecology changes the cost structures in small-scale farming systems by substituting capital-demanding inputs with labour and innovative technologies and practices to produce diverse farm outputs (**BOX 3.5**).

Sustainable intensification and agroecology have strong links to the circular economy through their emphasis on resource use efficiency and use of ecosystem services as well as encouraging the use of regenerative resources and preventing leakages of natural resources from the food system.

BOX 3.5 AGROECOLOGY AT IFAD

IFAD is part of the FAO-led multiagency initiative to scale up agroecology. All agencies have as a first task agreed to do an agroecology stocktaking of their portfolios. IFAD has developed an agroecology framework, based on the 10 agroecology elements approved by the FAO Council in 2019, and completed its stocktaking in 2020, analysing 207 projects (completed or to be completed between 2018 and 2023).

Of IFAD's projects, 13 per cent fully support the three core elements in agroecology in their activities, while another 47 per cent partially support agroecology approaches (two of the three or all three but not with all beneficiaries).

Projects supporting agroecology also score higher in supporting IFAD's mainstreaming priorities for nutrition, youth and climate change, while gender is doing well in all projects. They also give more support to indigenous peoples, confirming agroecology's social elements. Climate adaptation-focused funding, such as the Adaptation for Smallholder Agriculture Programme (ASAP), significantly contributed to enabling agroecology approaches in half of the projects fully supporting agroecology in the sample.

Source: Internal IFAD report.

Diversified incomes for decent and resilient livelihoods – not from farming alone

Within small-scale agriculture, a basic dualism exists between very large numbers of very small-scale farmers with less than 2 hectares of land – who derive only part of their income, and their food, from their own production – and a less numerous group whose larger farming operations (up to 20 hectares) produce most of the commercial food supply. The food produced by very small-scale farmers is vital to their income, food and nutrition security, and to local markets, but is unlikely to help meet the growing demands of urban populations (Woodhill et al., 2021).

Because of this dualism, policymakers must be careful not to conflate the challenge of tackling poverty and malnutrition among small-scale farming families with the different challenge of meeting growing urban food demand. The interventions that work best for larger producers – those aiming at commercialization – will differ from those focused on the very small-scale farmers. Generally, farmers' own production is a major component of food security and income, but cash-cropping and off-farm income are also critical (Frelat et al., 2016) (**BOX 3.6**).

Off-farm opportunities and diversification options

The prospects for improving poor smallholder well-being in sub-Saharan Africa through agricultural transformation alone are explored in a study by Giller et al. (2021), which focuses on six zones and uses two indicators: food self-sufficiency (threshold of 2,500 kcal/mean absolute error/day), and food security (measured against the same threshold using the food availability indicator, which converts all income into calories). In all six zones, households vary widely, yet the shape of the current distribution is very similar: few households are above the poverty line, obtaining a living

BOX 3.6 HIGH-VALUE AGRICULTURE IN NEPAL

Nepal's agricultural sector dominates the labour market, employing roughly two thirds of the working population, and contributes substantially to GDP. But food shortages remain a chronic issue for 4-9 months of the year, when half the districts are food-deficient and producers cannot earn wages to achieve self-sufficiency. The government has prioritized strengthening the agricultural sector, with empowering smallholder farmers as a first step.

The High-Value Agriculture Project sought to reduce rural poverty and improve food security in the rural mountainous areas by establishing producer organizations and forming farmer cooperatives. The producer services improved access to input, output and service markets – by streamlining value chains – and technical awareness training.

The project supported 15,745 direct beneficiaries and 107,860 beneficiaries in total; women constituted 47 per cent and ethnic minorities 25 per cent of all beneficiaries. It established or supported 456 producer organizations and built or rehabilitated 13 market processing facilities. Beneficiaries saw a 37 per cent increase in annual income (US$500), a 7-9 per cent increase in productive and livestock assets, a 5-6 per cent increase in market access in the dry and wet seasons, and a slight increase in dietary diversity. Technological adoption rates were high: 67 per cent of trained farmers adopted 50 per cent of the technologies introduced. Climate resilience was increased through polytunnels, allowing two or three crop cycles per year. Storage facilities reduced post-harvest losses, benefiting producers, market operators and the environment. And planting timur trees helped with soil conservation.

Source: High-Value Agriculture Project impact assessment technical report and policy brief.

income from agriculture, while the vast majority are among the region's poorest households. In four of the six zones, none of the households is food self-sufficient – producing enough food to feed the family – and in all six zones the highest rate of food self-sufficiency is half of households. The share of food-secure households is higher than the share of food self-sufficient households: even so, in none of the six locations are all households food-secure (Giller et al., 2021).

Narrowing yield gaps considerably increases the share of households that are food self-sufficient or food-secure across all six zones. Yet, even with the largest possible increases in yield, in only three of the six zones do a majority of households achieve food security or food self-sufficiency. For example, in Ethiopia, land is so constrained that, by narrowing yield gaps as much as is likely to be feasible, only 42 per cent of households would be food self-sufficient. By contrast, in Tanzania, closing yield gaps would lift 90 per cent of households above the food self-sufficiency threshold. Food security is not much different: in all cases, narrowing yield gaps makes the share of food-secure households only slightly higher than that of food self-sufficient households (Giller et al., 2021).

Enabling smallholder farmers to diversify production into high-value markets: some options

Two approaches that have shown some promise for raising smallholder farmers' incomes and improving their well-being are sustainability certification (Meemken, 2020) and linking small-scale producers to emerging high-value markets in fruits and vegetables (Ogutu, Ochieng and Qaim, 2020). It is clear that demand will soon grow for more nutritious diets and more diverse food – and even for high-value perishable foods, which offer ample economic opportunities for farming households. According to the Global Panel on Agriculture and Food Systems for Nutrition (2020), small-scale producers can play an important role as specialized producers of nutrient-rich foods, particularly through horticulture. Small-scale producers may even have a comparative advantage in certain types of fruit and vegetable production, particularly those that rely on high labour use with low capital requirements.

However, the degree to which future food demand will be inclusive and translate into viable futures for large numbers of more marginal, small-scale producers is questionable (Woodhill et al., 2020). It will depend largely on implementing measures that allow small-scale producers to overcome the barriers to producing and marketing their production.

Making food systems inclusive and equitable

A transformation of food systems that enables the production of sufficient nutrient-dense foods for consumers, achieved by sustainable agricultural intensification, does not automatically lead to inclusive and equitable food systems or better livelihoods for all. Without deliberate actions to ensure the inclusiveness of transforming to more sustainable production systems, poor people could be left behind or even harmed (Davis et al., 2021).

Without deliberate actions to ensure the inclusiveness of transforming to more sustainable production systems, poor people could be left behind or even harmed.

The fate of poor and marginalized rural people, especially women, youth and indigenous people, tends to be inadequately addressed in the process of agricultural transformation (Davis et al., 2021). Women are deeply involved in all phases of agricultural production, and at the plot level account for about 40 per cent of the total field work in crop agriculture in Africa (Palacios-Lopez et al., 2017). There is widespread consensus that women devote more time than men to many agricultural production-related activities such as seed selection, input purchasing and livestock care, and they certainly spend more time than men on household labour. Some suggest a potential gain in overall productivity by targeting women on specific objectives and actions, but there is not enough evidence to show what results this would entail (Doss, 2018). Even so, explicitly integrating gender considerations into strategies and targeting can help avoid missing some opportunities for productivity gains.

Food system interventions that take gender seriously and make the effort to transform and change existing gender norms and barriers may be more successful (Quisumbing et al., 2020).

Indigenous people are also often marginalized and left behind in strategies to improve agricultural livelihoods – even though they manage, or have tenure rights over, a quarter of the world's land surface, including about 40 per cent of all terrestrial protected areas and ecologically intact landscapes (Garnett et al., 2018). In rural areas, indigenous peoples are more than twice as likely as their non-indigenous counterparts to be living in extreme poverty (ILO, 2020). They are likely to be left behind by food system transformation as well – unless their knowledge, experience and desires are explicitly included in developing strategies and investments.

Developing off-farm opportunities

Given the importance of diversifying incomes for improving livelihoods, inclusive agricultural productivity growth has to proceed hand in hand with off-farm employment creation. In Asia and in Europe, agricultural intensification has always been accompanied by strong development of the non-agricultural economy (Giller et al., 2021). It has also been supported by trade policies – including protecting domestic markets, input subsidies and social protection. So far, Africa is following a different pathway, and employment opportunities outside the agricultural economy are insufficient to accommodate the huge rural labour force seeking economic opportunities. In many cases, people continue farming for lack of alternatives: a default strategy that further aggravates the fragmentation of land available for making a living from agriculture.

The emerging consumer markets for nutrient-dense foods afford opportunities for the production of more lucrative crops and animal protein sources on less land. Relevant areas include horticulture, pulses, chicken, fish and novel food such as insects (as outlined in CHAPTER 1). These trends all require the further development of midstream operations, which enhances opportunities to invest in agribusiness beyond the farm and create rural employment within the food system (Giller et al., 2021).

Even as farms become too small to provide a living wage from primary production, they remain critical for household income, as well as a key means of securing household access to nutritious foods. For smallholders' nutritional status to improve, a sharper focus is needed on producing diverse, nutritious foods that are – as far as possible – available year-round. This implies a production strategy different from that of maximizing commercial potential, with greater emphasis on diversified products whose labour requirements can be coordinated with non-farm employment needs.

Such integrated production systems differ greatly from the monoculture, high-input and grain-oriented food systems often promoted by government policies. Integrated systems are quite knowledge-intensive, based on circular resource use and, in many cases, on indigenous and local knowledge.

Better financing is essential to support needed transitions

Today's agricultural financing focuses mostly on the short term, excludes consideration of environmental and health values, and supports "perverse subsidies" that generate negative social and environmental outcomes. It fails to account for the increased risks associated with climate change, and is generally inaccessible to poor people and smallholders (Blended Finance, 2019; Lipper et al., 2021).

Financing is key to enabling change and creating incentives for change. This is a question not merely of increasing financing, but also of improving the enabling characteristics of financing to support transformation. Redirecting capital into circular, environmentally sustainable models of food production should generate higher-quality, lower-risk economic growth by opening new business opportunities. The Business and Sustainable Development Commission estimated the value of investments in more knowledge-intensive, resource-efficient and nature-based systems at up to US$2.3 trillion/year (Blended Finance, 2019).

To make agricultural financing work for food system transformation, action can be taken on four fronts:

- **Much greater coordination is needed in public sector financing.** In 2018, bilateral Development Assistance Committee donors reported 13,649 aid activities for agriculture, with average funding of US$0.5 million per activity, while multilaterals accounted for 2,275 aid activities, with average funding of US$1.2 million. At the country level, an abundance of small uncoordinated projects causes high transaction costs for recipient countries. The international financial institutions and the United Nations system at large often individually pursue country assistance strategies that are parallel exercises that struggle to converge on a common framework (Bharali, 2020).
- **More innovation is needed in the use of blended finance and private sector involvement.** Blended finance involves the use of different financing sources and instruments to finance investments that have both commercial and social returns. One of the most promising for agricultural transformation is blending with climate finance. For example, an investment may involve promotion of sustainable, diversified food production systems with climate-resilient crop varieties, and "climate-proof" infrastructure along a value chain. This may result in reduced losses, more consistent market access, improved local and national food security, and increased incomes for stakeholders along the value chain. In such a context, a combination of grants, concessional loans and equity resources may be justifiable to provide adequate incentives to achieve a desired result. The climate finance flows to small-scale agriculture in developing countries were estimated to average US$10 billion annually in 2017/2018. This was a very small share (1.7 per cent) of total climate finance, but it still represents a significant potential source for blended finance options in the future (Lipper et al., 2021).

- **Partnerships between public sector financing organizations and civil society organizations need to be expanded and deepened.** This is the case especially at the grass-roots level – and the role of these partnerships throughout the full project cycle (including monitoring and evaluation) needs to be expanded for sustainable impact. But in-depth consultation with groups on the ground at potential project sites takes time, it takes extra funds and capacity, and it takes the slow building of relationships and trust.
- **Instruments are needed that allow for the integration of environmental values into agricultural systems.** These could range from supply chain innovations that create sustainability performance incentives through labelling, to payment for ecosystem service programmes linked to agricultural investments, to sustainability-linked debt – including loans and bonds with environmental conditions attached – and to nature-linked insurance, based on adaptation and improved resilience driven by better environmental management (Blended Finance, 2019).

Policy priorities for nutrient-dense, knowledge-intensive, circular and equitable agricultural systems

Transforming the food system creates an opportunity to rethink small-scale farming within a wider vision, oriented towards improved livelihoods, better nutrition and environmental sustainability (Woodhill et al., 2020). To include rural smallholders in this new vision, such incentives must target livelihood opportunities to specific rural smallholder groups – both on and off the farm – beginning with women and youth.

Policymakers and other food system stakeholders should:

- **Create opportunities for smallholder farmers to diversify, both for income and for improved on-farm food supplies.** Smallholders should be offered extension support for a wider range of crops – along with market access, in cases where diversification is beneficial for income growth. Approaches should vary with a food system's type and stage of development: interventions for a traditional food system need to differ from those for an emerging food system. Increasing the access that small-scale producers have to productive assets, including knowledge and market linkages, cuts across all food system types. In creating opportunities to diversify, attention to women and youth is important. This implies the promotion of more equal access to productive assets between generations and between men and women.
- **Enhance a transformation towards sustainable production based on principles of circularity to move away from maximizing agricultural output to optimizing natural resource use.** The current set of policies and institutions governing agricultural production systems generally

do not enable or incentivize sustainable production, and instead encourage practices that generate environmental damage and waste. A fundamental reframing of the policy and institutional system will involve changes in institutions/policies to incentivize conservation and sustainable use of ecosystem services in agricultural production systems – including regulations and taxes to reduce degradation/depletion and payments for ecosystem services. This transformation will require a significant transition period because of the time required to build and restore ecosystem services and for farmers to adopt new knowledge-intensive techniques. Planning and budgeting for a transition stage is essential to obtaining long-term success. There are good opportunities to combine agricultural development and climate financing to support transitions and multiple objectives (Lipper et al., 2021). This is an important lever of change for moving to sustainable and resilient production systems.

- **Inform this shift in production with a research and development (R&D) agenda that focuses on providing evidence and advice – and support a major expansion of public and private agricultural extension services to accelerate the use of digital technologies by smallholders.** Because sustainable resource management best practices are highly localized and knowledge-intensive, massively increased investment in local adaptive farm-level research and extension systems will be required to catalyse sustainable intensification in Africa (Jayne et al., 2019). With public expenditure on R&D lagging in many low- and middle-income countries, this will require higher national budgets for R&D. Different stakeholders will be implementing locally specific processes based on various sources of knowledge, including farmer-led and scientific knowledge and innovation. Non-research partners, extension services, NGOs, and producer associations and organizations – as well as large agricultural companies upstream and downstream – will have to be involved (Caron, 2014). This challenges the divide between public and private research and farmer-led indigenous knowledge and innovation. It will also be necessary to synchronize the promotion of more pluriform and digital outreach through extension services and midstream service providers. Efforts to reach the enormous and diverse community of smallholders must be intensified, and all available instruments deployed. Scaling up current outreach will require the massive application of digital technologies, because the human resources in public and private extension services will not be adequate to reach the masses of smallholders. And, drawing lessons from recent experiences with service delivery dominated by men, attention must be given to including women and youth.

Simulation 3 in annex 1 illustrates how halving yield gaps in cereals and fruits and vegetables, against a business-as-usual baseline, has an impact on inclusiveness, nutrition and the economy.

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CHAPTER 4

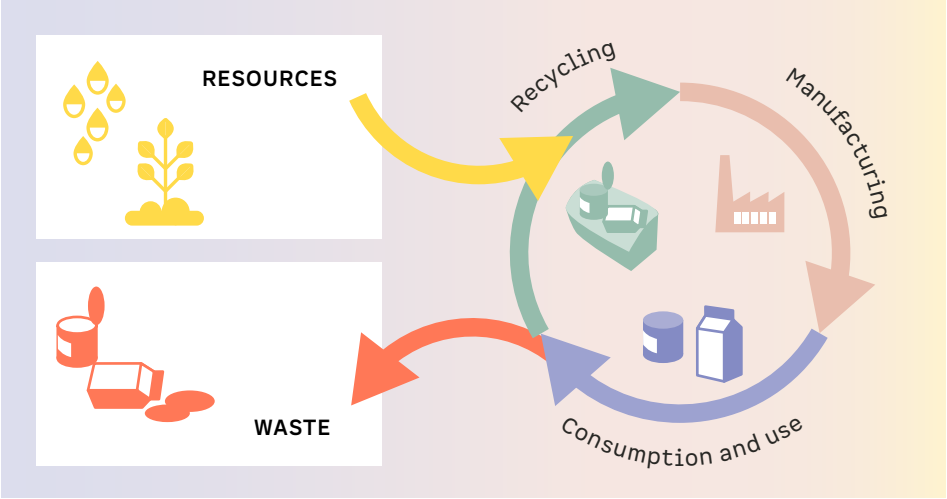
Reconsidering inputs, reducing losses and recycling waste in circular agrifood systems

Losses and waste occur throughout food systems: farm-level practices allow for nutrient depletion, food value chains suffer post-harvest losses, and households and communities generate solid and liquid waste and human excreta. These considerable losses and waste can be lessened if material flows can be shifted towards reducing, reusing and recycling – by transforming linear food systems into more circular ones. In addition, new technologies and biotechnology can advance this transformative shift through novel foods and fertilizers that lead food systems away from fossil fuel dependence.

This chapter explores two broad strategies for making food system resource use more sustainable and efficient. One is training farmers, traders and households in better resource management practices. The other is improving resource use technologies. Both strategies aim to gradually decouple growth from the use of finite resources, arriving at a circular economy that is regenerative by design and uses intensive feedback among food system components to recycle and reduce material losses (**FIGURE 4.1**).

More specifically, the chapter looks at how to promote integrated resource management throughout the food system, how to reduce food losses in agricultural value chains, how to recycle nutrients in production systems (using external inputs more efficiently) and how to use incentives to recover more household waste. Two strategies can engage stakeholders to transform food systems in a more circular direction: first, new technical opportunities – with human investments in training and awareness-raising – and, second, financial incentives to encourage adaptive behaviour.

FIGURE 4.1 CIRCULAR ECONOMY PRINCIPLES FOR TRANSFORMING FOOD SYSTEMS



Source: Nextstep.

The chapter develops five key messages:

1. **Circular principles will make food systems not only more sustainable but also more efficient** – by increasing agricultural yields, by increasing food production and by creating value added in agrifood chains.
2. **Supporting nutrient recycling opportunities at farm, regional and national levels requires specific practices, programmes and policies** – specifically those that enable substantial cost reduction, more diverse and resilient production systems, and more efficient energy and water use.
3. **Interventions to reduce food losses at different stages of the food value chain vary by region, food group and value chain component** – yet they generally combine new technologies, better handling practices and supportive market incentives to improve productivity and food quality while reducing externalities.
4. **Household waste and human excreta can become important sources of nutrients and energy for improving food systems** – and can be recovered with community organization.
5. **Advances in developing a biobased economy are promising** – these, too, can add to circular food systems.

How do we shift food systems towards circular resource use for sustainability and resilience?

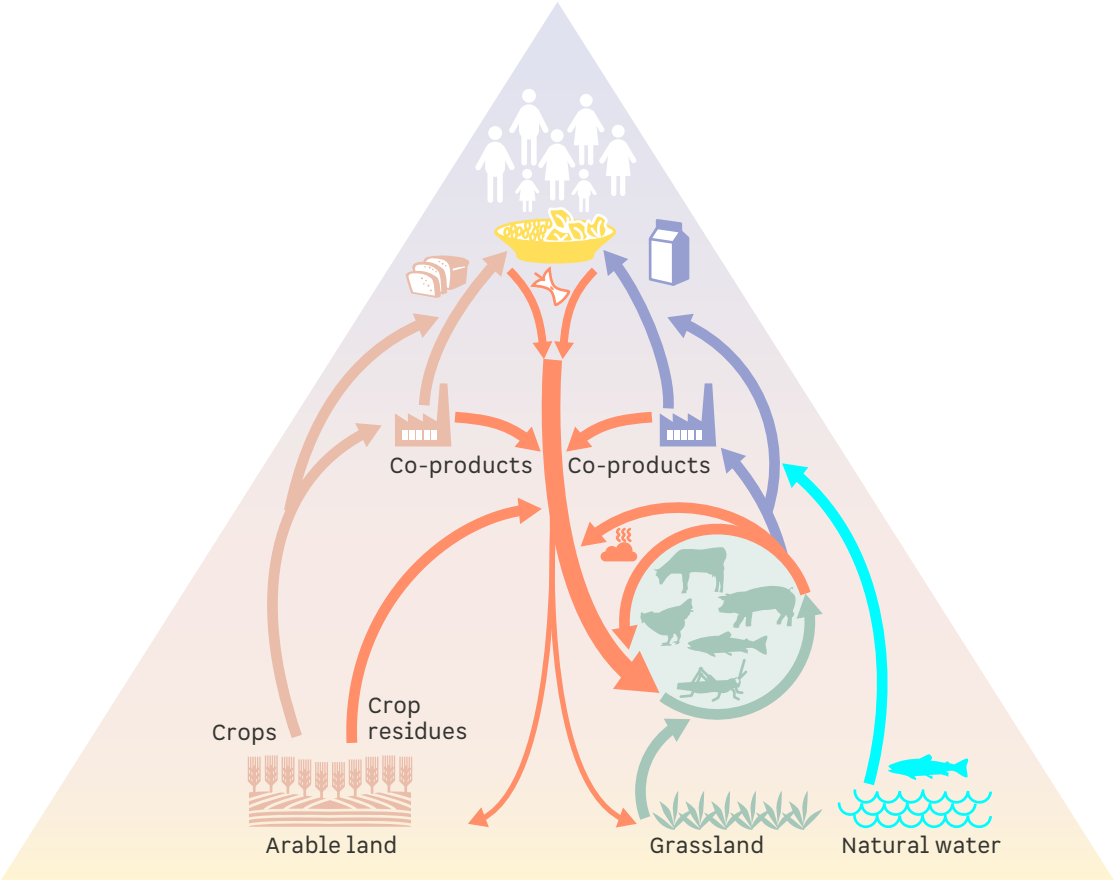
Our society can be greener and more sustainable if we adopt measures aimed at reusing organic material from crops, aquatic biomass and residual flows produced in the agricultural sector. Circular food systems are based on the principle of optimizing all biomass use. The waste streams from one supply chain can be the raw materials for another.

Circularity implies loss prevention, recovery for reuse, remanufacturing and recycling. The concept of circularity originates in industrial ecology, which aims to reduce resource consumption and emissions to the environment by closing the loop of materials and substances (Ghisellini et al., 2016; Jurgilevich et al., 2016). Under this paradigm, losses of materials and substances should be either prevented or recovered for reuse, remanufacturing and recycling.

In the food system, circularity is biophysical (**FIGURE 4.2**), and plant biomass is its basic unit. Farm animals are most effectively used to unlock biomass that is inedible for humans, turning it into valuable food, manure and other ecosystem services. Moving towards biophysical circularity in the food system implies searching for practices and technology that:

- Rely as little as possible on the use of finite resources, such as land and phosphate rock.
- Encourage the use of regenerative resources, such as wind and solar energy.
- Prevent leakage from the food system of natural resources, such as nitrogen and phosphorus.
- Stimulate the reuse or recycling of resources that are inevitably lost – such as those in human excreta – in a way that adds the highest value to the food system (Ghisellini et al., 2016; Jurgilevich et al., 2016).

FIGURE 4.2 BIOPHYSICAL CIRCULARITY IN THE FOOD SYSTEM



Source: van Zanten et al., 2019.

In particular, natural nutrient cycles must be restored to agrifood waste systems. Doing so is necessary for three reasons:

- To reduce the environmental harm that currently results from excess nutrients.
- To conserve valuable resources.
- To safeguard future food security (van der Wiel et al., 2019).

"Hotspots" – such as manure, waste and even human excreta – make good subjects for analysis, if they can be recycled safely and in a way that is acceptable to users. Processing costs have to be low and transportation distance small. Contrasting examples of circular and linear food systems are described in **BOX 4.1** and **BOX 4.2**.

BOX 4.1 LARGELY CIRCULAR: INTEGRATED AGRICULTURE AND AQUACULTURE IN VIET NAM

A high degree of circularity is found in the integrated rice-fish systems of the lower Mekong delta, Viet Nam. At such farms, 30-40 per cent of the farm area is dedicated to trenches for storing water, which helps in dry-season irrigation-water management, and the water area is used for fish production. Depending on the location, such farms can include freshwater shrimp as well as fish. Dissolved run-off fertilizer from the fields enters into the trenches and allows growth of algae and other natural food, the main nutrients for the fish. During the wet season, the fish encroach on the paddy section and the faecal waste released on the flat ground works as fertilizer for the paddy as well. At the end of each culture cycle, the bottom sludge of the trenches is taken out and used in the vegetable beds on the dykes in the farms. When vegetables are harvested, the roots are often mixed with the soil of the flat rice bed by ploughing.

Source: Berg et al., 2012; Bosma et al., 2012.

BOX 4.2 LARGELY LINEAR: SOY MEAL AS ANIMAL FEED FOR EXPORT IN LATIN AMERICA

A largely non-circular system is the global chain of soy meal, grown in Latin America initially to feed animals and subsequently also humans in Europe and Asia. Using nitrogen as a marker reveals five phases in the development of Brazilian soybean systems: forest conversion, soybean cultivation, transport and processing, consumption and waste disposal. The nitrogen that eventually ends up in meat, milk and eggs from soy meal-fed animals is estimated at around 20 per cent of the nitrogen in the freshly crushed soy meal. More than half of the lost nitrogen can potentially be recycled, though mostly far away from soybean production. Recycling these losses can make local and national food systems more circular, but the overall soybean chain is not circular, based as it is on growing animal feed for far-away destinations.

Source: Smaling et al., 2008.

How can smallholder farmers contribute to circular systems?

The circular economy is highly dependent on the management of soils and land to perform four basic functions:

- Producing food and other biomass.
- Storing, filtering and transforming many substances, including water, carbon and nitrogen.
- Providing fresh mineral resources and fossil fuels.
- Remaining a functional platform for nature and human activities (Breure, Lijzen and Maring, 2018).

As the human population grows, the demand for resources increases. Soil and land management are central to the circular economy – to maximize the reuse of resources and products, and to reduce resource depletion to a minimum.

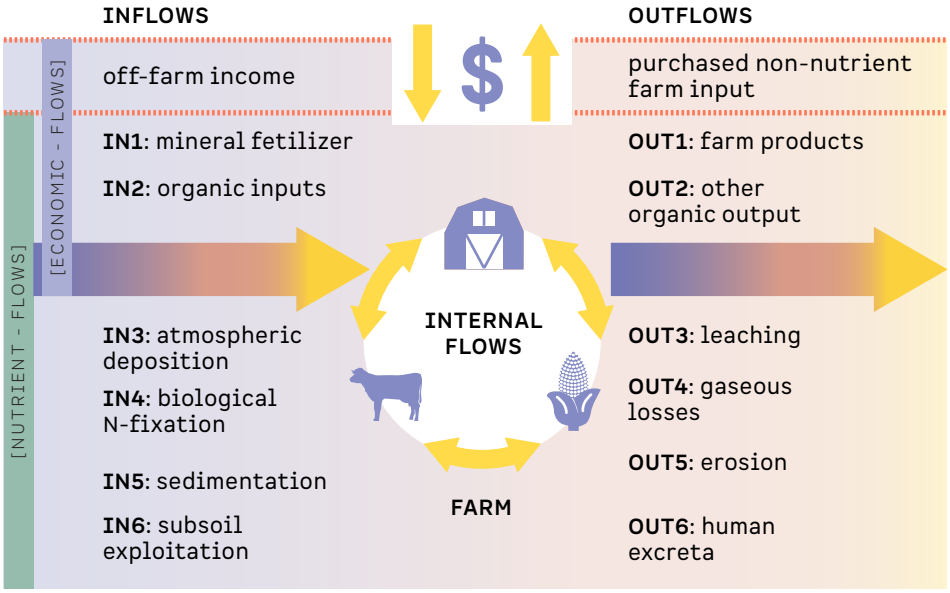
In assessing the circularity of farming systems, soil carbon and nutrient stock and flow analysis can help

To reduce inorganic fertilizer purchases and to control emissions, natural nutrient cycles will have to be restored to agrifood systems. Restoring these cycles implies balancing stocks and flows of carbon and nutrients – nitrogen, phosphorus, potassium – to support circularity and to enhance ecosystem services. Nutrient cycles can be restored at farm scale, subregional scale or national scale. Nutrient balances can be an indicator to determine nutrient-use efficiency of farming systems.

A comprehensive literature review on Africa (Cobo, Dercon and Cadisch, 2010) showed nutrient balances being widely used across the continent. In the 57 peer-reviewed studies surveyed, most balances were calculated at plot and farm scale, and most were generated in East Africa. Data confirmed the expected trend of negative balances in the continent for nitrogen and potassium: fewer than 75 per cent of the selected studies had mean values below zero.

Many approaches follow NUTMON (Smaling and Fresco, 1993), which is based on an analysis of nutrient inputs, outputs and internal flows related to recycling (**FIGURE 4.3**). The analysis of nutrient balances is adopted as a way to assess the degree to which farming systems are circular. Along with the assessment of carbon and nutrient balances, the assessment of stocks – the carbon and nutrients available in soils – is equally important: the combination of the two indicates the rate at which carbon and nutrients decline or accumulate in soils, farms and regions.

FIGURE 4.3 NUTRIENT INPUTS, OUTPUTS AND INTERNAL FLOWS IN A FARMING SYSTEM



Source: Based on Smaling and Fresco, 1993.

Of the nutrient flows commonly considered, four are regarded not only as nutrient flows but also as economic flows, because of their relatively straightforward monetary value: IN1 (mineral fertilizer), IN2 (organic inputs), OUT1 (nutrients in removed crop parts) and OUT2 (nutrients in removed crop residues). The other flows – while contributing to environmental goods and bads – are harder to quantify in monetary terms (see **FIGURE 4.3**).

The NUTMON approach can be used at any spatial scale, as long as the system boundaries are clearly defined. It was first developed for African farming systems, where numerous studies have focused on Kenya (De Jager et al., 1998), Ethiopia (Abegaz, 2005), Uganda and Burkina Faso (Agwe et al., 2007). These studies in sub-Saharan Africa reveal – almost unequivocally – alarming carbon and nutrient depletion rates. NUTMON has also been applied in Asia, with studies focusing on China and Viet Nam (Dang, 2005; Lam et al., 2005; Khai et al., 2007) India (Surendran and Murugappan, 2007) and Thailand (Wijnhoud, 2007).

Studies of high-production irrigated areas in Asia have found that multiple cropping leads to fertilizer use (IN1) and nutrient removal in crops (OUT1) at rates far exceeding those for rainfed agriculture. Irrigated systems bordering the Asian highlands also have free nutrient lunches through IN5. The interaction between livestock, organic manure (IN2) and the fate of crop residues (OUT2) is relevant in determining levels of circularity. Other mechanisms for increasing circularity are reducing atmospheric nitrogen emissions, erosion control and reuse of human excreta (decreasing OUT4, OUT5 and OUT6 in **FIGURE 4.3**).

Farmers rely on composting practices, green manure (cover crops) and household organic waste to improve soil fertility and soil organic matter content, which reduces input purchases and enhances yields

An alternative to manufacturing mineral fertilizers – which is energy intensive and adds to greenhouse gas (GHG) emissions – is to use organic fertilizers. One organic fertilizing method is to include nitrogen-fixing species, such as beans, in farming systems, thus increasing IN4. Another method is to use compost from pits and heaps, or in integrating trees that root deep and bring up "new" nutrients through leaf fall. Yet another organic fertilizing method is manuring, which allows for integrated crop-livestock systems. This can take place at farm scale, where zero-grazing animals feed on crop residues and fodder crops, but it also occurs at larger "system" scale, as in Sahelian West Africa. There, pastoralist cattle often spend the night in rings around villages, fertilizing them with their urine and faeces with nutrients obtained from the bushland farther away (Samaké et al., 2005). After the growing season, abundant sorghum and millet residue from production on these lands is then fed to the animals. More generally, the recycling of crop residues in integrated crop-livestock systems can improve overall system performance, allowing "preferred plot" manuring schemes for high-value crops.

Recycled organic materials can be separated into two categories: those already part of the system – compost, household waste, manure from animals not receiving concentrates – and those entering the system as inputs from outside. In many African countries, commercial livestock clusters are developing at the fringes of cities, yet nearby farms scarcely use the manure generated there. Its value as fertilizer may not be recognized, and legal standards for its use may be lacking. So when researchers work with large amounts of farmyard manure or compost – as they often do – their results may not be realistically applicable to the average African farm (Ejigu et al., 2021).

Much is gained from the combined use of mineral and organic fertilizers (IN1 + IN2). This combination often gives better production results than either fertilizer type by itself. In addition, the combination maintains better soil quality, expressed in pH and organic carbon content. The challenge lies in ensuring that sufficient organic inputs are available at the farm level. But at the same time, conducive policies are needed to take these farming systems to a higher level – that is, to environmental compensation, carbon credits, extension geared towards adopting green technologies, and so on.

And not to be neglected is the reuse of organic waste on farms and beyond for energy. Increasingly, biodigestion is promoted to supply energy for cooking and other purposes, particularly where there is no connection to the electricity grid (Muvhiiwa et al., 2017). The other side of this coin is that carbon and volatile nutrients such as nitrogen and sulphur will be lost from the productive system. Another example of competing use of the same resources is the selling of dung cakes as a source of fuel in Ethiopia, and the widespread practice of using dung to plaster houses. The product serves a clear purpose, but the nutrients are taken out of the system.

How and where can food losses in the food system value chain be reduced?

International attention to food loss and waste (FLW) is clearly affirmed in the 2030 Agenda for Sustainable Development. Awareness began to increase with a few publications that raised the profile of FLW (Parfitt et al., 2010; FAO, 2011). According to rough estimates, a third of all food produced was lost or wasted. These rough estimates are now being replaced by two indices, thanks to efforts by the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Environment Programme to estimate more carefully and precisely how much food is lost in production and in the supply chain before the retail stage (the Food Loss Index) and how much is then wasted by retailers and consumers (the Food Waste Index). Even so, researchers more widely still lack common and agreed definitions of food loss and food waste (**BOX 4.3**).

BOX 4.3 DEFINING FOOD LOSS AND FOOD WASTE

How should food loss and food waste (FLW) be defined? The answer has important implications both for the estimation methodology used to examine FLW and for the interpretation of results. Although the terms "post-harvest losses", "food loss", "food waste" and "food loss and waste" are frequently used interchangeably, they hardly ever refer consistently to the same concept. Two recent definitions of FLW distinguish between loss and waste, but they do so in different terms. FAO defines food loss as unintended loss of food during harvesting, post-harvest handling, processing and distribution, in contrast to food waste, which is food that gets lost at the retail and consumption stages (FAO, 2011). For the World Resources Institute, food loss is "the unintended result of an agricultural process or technical limitation in storage, infrastructure, packaging, or marketing", while food waste is "food that is of good quality and fit for human consumption but that does not get consumed because it is discarded" (Lipinski et al., 2013).

The table below summarizes some issues that arise from different conceptualization and measurement frameworks in assessing various value chain breakdowns (Fabi et al., 2021).

FOOD CHAIN BREAKDOWN IN STAGES UNDER THE MAIN CONCEPTUAL FRAMEWORKS

SDG 12.3		FOOD LOSSES INCLUDING POST-HARVEST LOSSES						FOOD WASTE		
Stages	Pre-harvest	Harvest/ slaughter/ catch	On-farm post-harvest	Storage	Transport	Processing	Wholesale	Retail	Consumption	
SDG 12.3 Food Loss Index	Out of scope	Included at country level	On-farm post-harvest (all activities)	Storage	Transport	Processing and packaging	Wholesale	Out of scope Covered by the Food Waste Index		
African Union	Out of scope	Harvesting		Storage	Transpor-tation	Processing	Packaging and marketing[a]		Out of scope	
EU 2019 directive[b]	Out of scope	Primary production		Out of scope		Processing and manu-facturing	Retail and other distribution of food		Restaurants and food services	Household
HLPE	Included	Harvest and initial handling stage (on- and off-farm)		Storage (on- and off-farm)	Transport and logistics	Processing and packaging	Unclear	Retail		Consumption (household)
FLW Protocol[b]	Included	Production		Handling and storage	Processing and packaging		Distribution and market		Consumption	
EU FUSIONS	Can be considered	Primary production ready for post-harvest				Processing and manu-facturing	Wholesale	Retail and redistribution	Out of home	In home
FAO 2011	Out of scope	Production		Post-harvest handling and storage (off-farm)		Processing	Distribution (wholesale and wet retail markets, supermarkets)			Consumption

[a] The African Union monitoring and evaluation methodology requires two separate loss percentages for packaging and marketing.
[b] Entities can be classified using ISIC (International Standard Industrial Classification of All Economic Activities) or NACE (Statistical Classification of Economic Activities in the European Community) codes, thus with more detail than the main stages outlined in the conceptual framework.

Note: FUSIONS, Food Use for Social Innovation by Optimising Waste Prevention Strategies; HLPE, High Level Panel of Experts on Food Security and Nutrition; SDG, Sustainable Development Goal.

Source: Authors, based on FAO et al., 2018; HLPE, 2014; WRI, 2016; EU FUSIONS, 2014; EU, 2019; and FAO, 2011.

Food loss and waste estimates still face conceptual challenges, but action is needed

Although FLW reduction is now at the forefront of policy discussions, evidence on the topic is sparse – and the available studies use heterogeneous methods and definitions. A number of publications have started to provide insights that can help in designing protocols (FLW Protocol, 2016) and interventions to reduce FLW (for example, Affognon et al., 2014; Bellemare et al., 2017; FAO et al., 2019; Reynolds et al., 2019; Delgado et al., 2021). Because of estimation difficulties, product seasonality and market sensitivity to food quality, most studies analyse the quantity of food loss in terms of weight reductions (HLPE, 2014; Hodges et al., 2014). Some studies further translate quantity losses into caloric terms (Lipinski et al., 2013; Kummu et al., 2012; Buzby et al., 2014), but these studies still do not capture qualitative dimensions, such as loss of nutritional content and altered physical appearance (Affognon et al., 2014).

While the need to continue monitoring and building an evidence base is clear, policymakers also need current guidance – even if such guidance can be based only on the limited information at hand. Torero Cullen (2021) suggests that four dimensions should drive FLW agendas:

- How much food is lost and wasted, and where and why does this happen?
- What are the underlying reasons or objectives for reducing FLW – do they pertain to efficiency, food security or the environment?
- How effective have interventions on food losses been, and how much can be recycled back into the food system as a result?
- Does evidence exist on interventions and incentives that can help to reduce FLW, and if so do these activities create employment and enhance small and medium-sized enterprise activities?

Food loss and waste can therefore be addressed only with tailored strategies that focus on critical bottlenecks

Reducing food crop losses is critical to sustainably increasing agricultural productivity. Because food loss takes widely varying forms for various types of farmers, products and linkages within the midstream, it can be effectively addressed only by combining different interventions and targeting multiple stakeholders (**BOX 4.4**).

BOX 4.4 REDUCING POST-HARVEST LOSSES IN RWANDA

Rwanda's rural population continues to depend on agricultural activities for income generation. Reducing post-harvest losses is essential to maintaining high sales volumes, but climatic irregularities pose a serious threat to agricultural productivity, with yearly losses estimated at between US$50 million and US$300 million as a result of unpredictable periods of drought and torrential rain.

An IFAD project was implemented to combat climatic irregularities by tackling post-harvest losses at multiple stages of the value chain through several technological interventions. Working with the Government of Rwanda's Strategic Plan for the Transformation of Agriculture, the project assisted in the construction of modern post-harvest infrastructure to support smallholder farmers' productivity. Support was provided through business investments in drying, processing, value addition, storage, and logistics services for smallholder farmers.

The project has supported more than 55,000 members of 277 cooperatives through hub services, training and climate mitigation and information services. Roughly 5,500 farmers have been trained by the Rwanda Meteorology Agency, and an additional 6,000 farmers continue to receive daily text messages on weather forecasting. The completion of research and development of drought- and flood-resistant seed strains has supported farmers' ability to adapt to climate change. Post-harvest losses have come down by 20 per cent, and beneficiary incomes have increased by 10 per cent on average as a result.

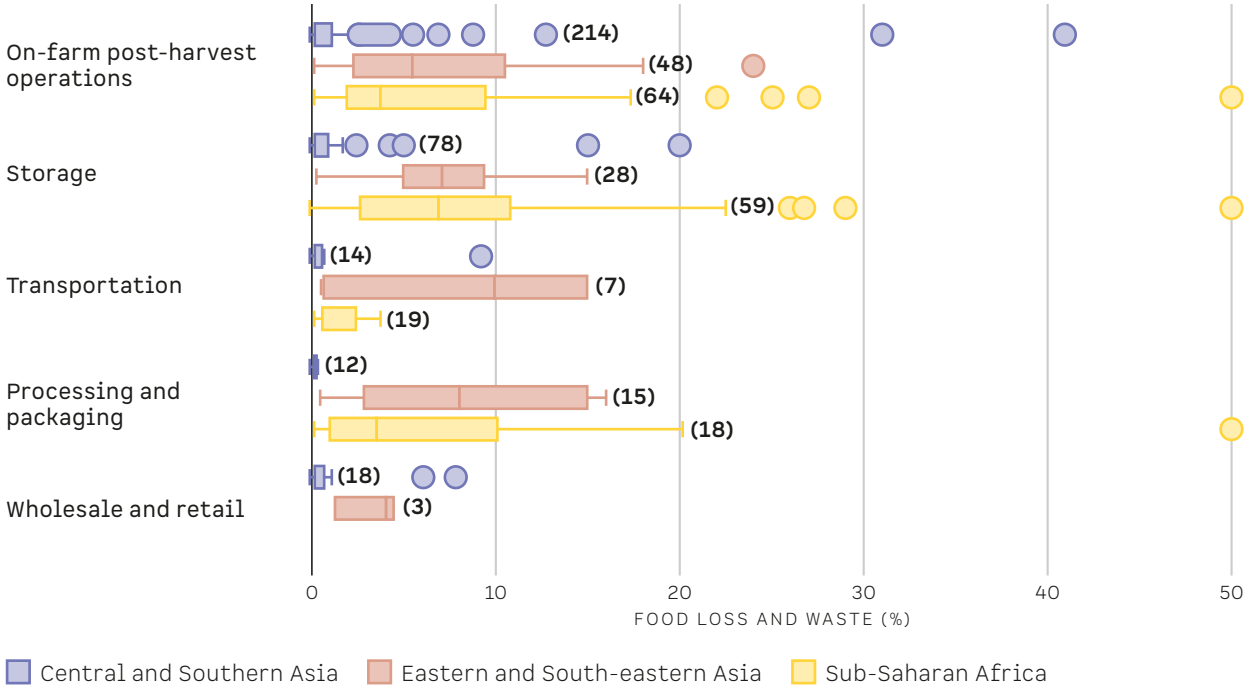
Source: IFAD project completion report.

FAO et al. (2019) reports an average global food loss of 14 per cent. Remarkably, Central and Southern Asia have food losses over 20 per cent, while East and South-East Asia have losses below 10 per cent. Sub-Saharan Africa is close to the global average. On a product group basis, roots, tubers and oil have losses of 25 per cent, fruits and vegetables just over 20 per cent, meat and animal products just over 10 per cent and cereals and pulses just below 10 per cent.

FAO et al. (2019) also offers comparisons by region, product group and stage in the value chain, enhancing insights and entry points for targeted policies. Losses in fruits and vegetables in sub-Saharan Africa are largely in the post-harvest stage and to a lesser extent in storage and wholesale (**FIGURE 4.4**). But in East and South-East Asia, the losses are mainly in storage and in packaging and processing. For meat and animal products, sub-Saharan Africa is the only region having large losses, in the post-harvest/slaughtering and storage stages.

FIGURE 4.4 REPORTED FOOD LOSS AND WASTE PERCENTAGES BY SUPPLY CHAIN STAGE, 2000-2017

A. CEREALS AND PULSES



B. FRUITS AND VEGETABLES

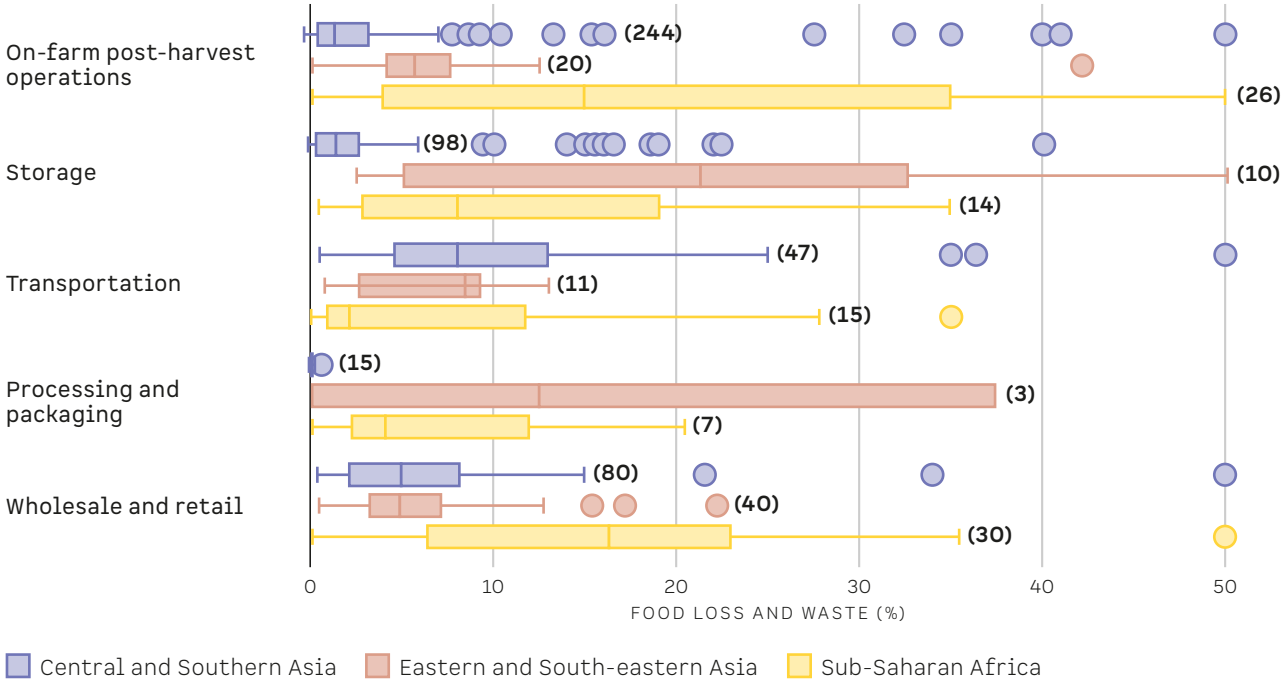
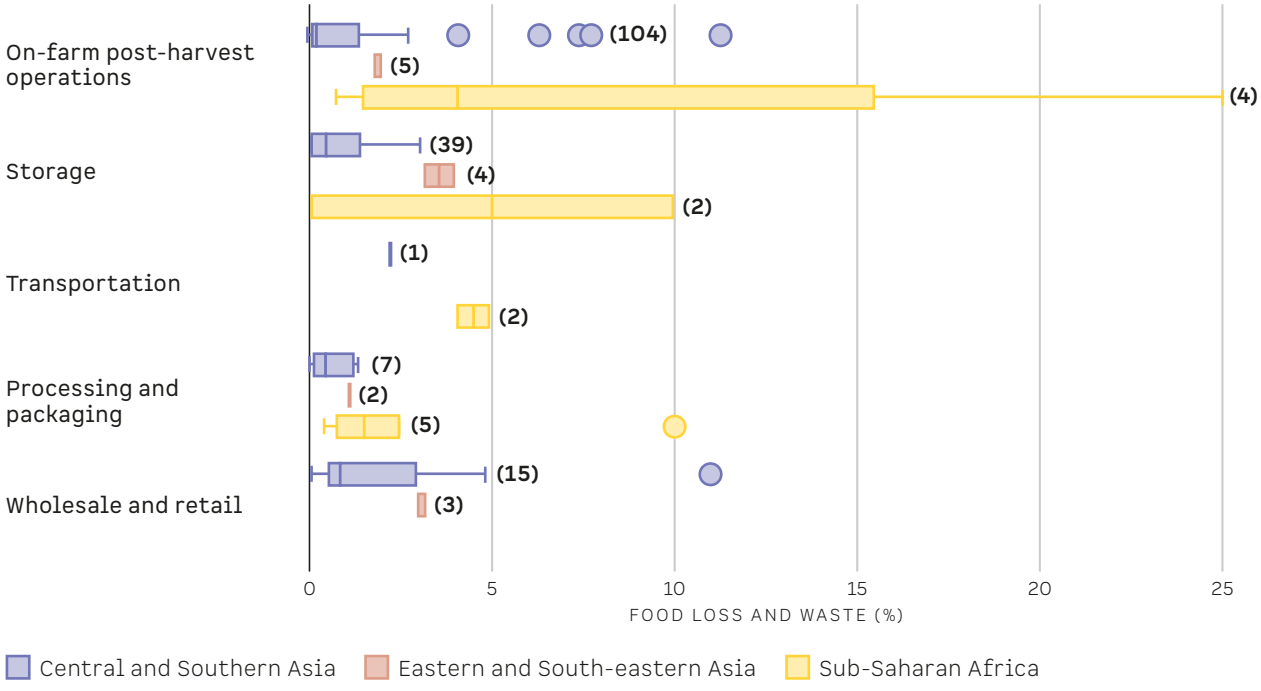


FIGURE 4.4 (CONT.)

C. ANIMAL PRODUCTS (INCLUDING FISH)



Source: FAO et al., 2019.

Using **TABLE 4.1**, priorities can be set for intervention. Torero Cullen (2021) developed an intervention classification, based on median values for region-product-value chain segment losses, with lows, highs and medians as determinants. The first segments to target for intervention are the cells with bold median values: storage and processing/packaging in fruits and vegetables in Central and Southern Asia, and post-harvest losses and wholesale/retail in fruits and vegetables in sub-Saharan Africa. Although no partitioning was possible for meat and animal products, **FIGURE 4.4** suggests that attention to these products should largely focus on slaughter and storage losses in sub-Saharan Africa (**BOX 4.5**).

TABLE 4.1 PRIORITY INTERVENTION AREAS BY REGION, PRODUCT GROUP AND STAGE OF THE VALUE CHAIN

REGION	PRODUCT	ON-FARM POST-HARVEST/ SLAUGHTER	STORAGE	TRANSPORTATION	PROCESSING AND PACKAGING	WHOLESALE AND RETAIL
Central and Southern Asia	Cereals and pulses	Low: 0 Median: 0.4% High: 2.6%	Low: 0 Median: 0.5% High: 2.1%	Low: 0.1% Median: 0.5% High: 0.7%	Low: 0.02% Median: 0.1% High: 0.3%	Low: 0.02% Median: 0.2% High: 1.1%
	Fruits and vegetables	Low: 0 Median: 1.3% High: 7.7%	Low: 0 Median: 1.4% High: 5.9%	Low: 0.4% Median: 8% High: 25%	Low: 0 Median: 0.03% High: 0.25%	Low: 0.3% Median: 5% High: 15%
	Meat and fish	Global average over value chain up to but excluding retail: 12%				
East and South-East Asia	Cereals and pulses	Low: 0.2% Median: 5.5% High: 18%	Low: 0.3% Median: 7.2% High: 15%	Low: 0.5% Median: 10% High: 15%	Low: 0.5% Median: 8% High: 16%	Low: 1.2% Median: 4% High: 4.5%
	Fruits and vegetables	Low: 0 Median:5.7% High: 12.5%	Low: 2.5% **Median: 21.3%** High: 50%	Low: 0.8% Median: 8.4% High: 13%	Low: 0 **Median: 12.5%** High: 37.5%	Low: 0.5 Median: 4.9% High: 12.7%
	Meat and fish	Global average over value chain up to but excluding retail: 12%				
Sub-Saharan Africa	Cereals and pulses	Low: 0.1% Median: 3.7% High: 17.3%	Low: 0 Median: 6.9% High: 22.5%	Low: 0.1% Median: 2.3% High: 3.7%	Low: 0.1% Median: 3.5% High: 20.2%	No data
	Fruits and vegetables	Low: 0 **Median: 15%** High: 50%	Low: 0.5% Median: 8.1% High: 35%	Low: 0.3% Median: 2.1% High: 28%	Low: 0 Median: 4.1% High: 20.5%	Low: 0.2% **Median: 16.3%** High: 35.5%
	Meat and fish	Global average over value chain up to but excluding retail: 12%				

Source: Torero Cullen, 2021.

BOX 4.5 ARTISANAL FISHERIES PROMOTION IN MOZAMBIQUE

Small-scale artisanal fishing constitutes 90 per cent of fishing activity in Mozambique. Fishers in this subgroup commonly lose a portion of their catch due to a lack of processing equipment and the limited availability of ice and storage containers. To ensure minimal post-harvest losses for artisanal fishers, an IFAD project aimed to increase incomes and livelihoods through improved storage techniques and the provision of reliable infrastructure conducive to fish storage.

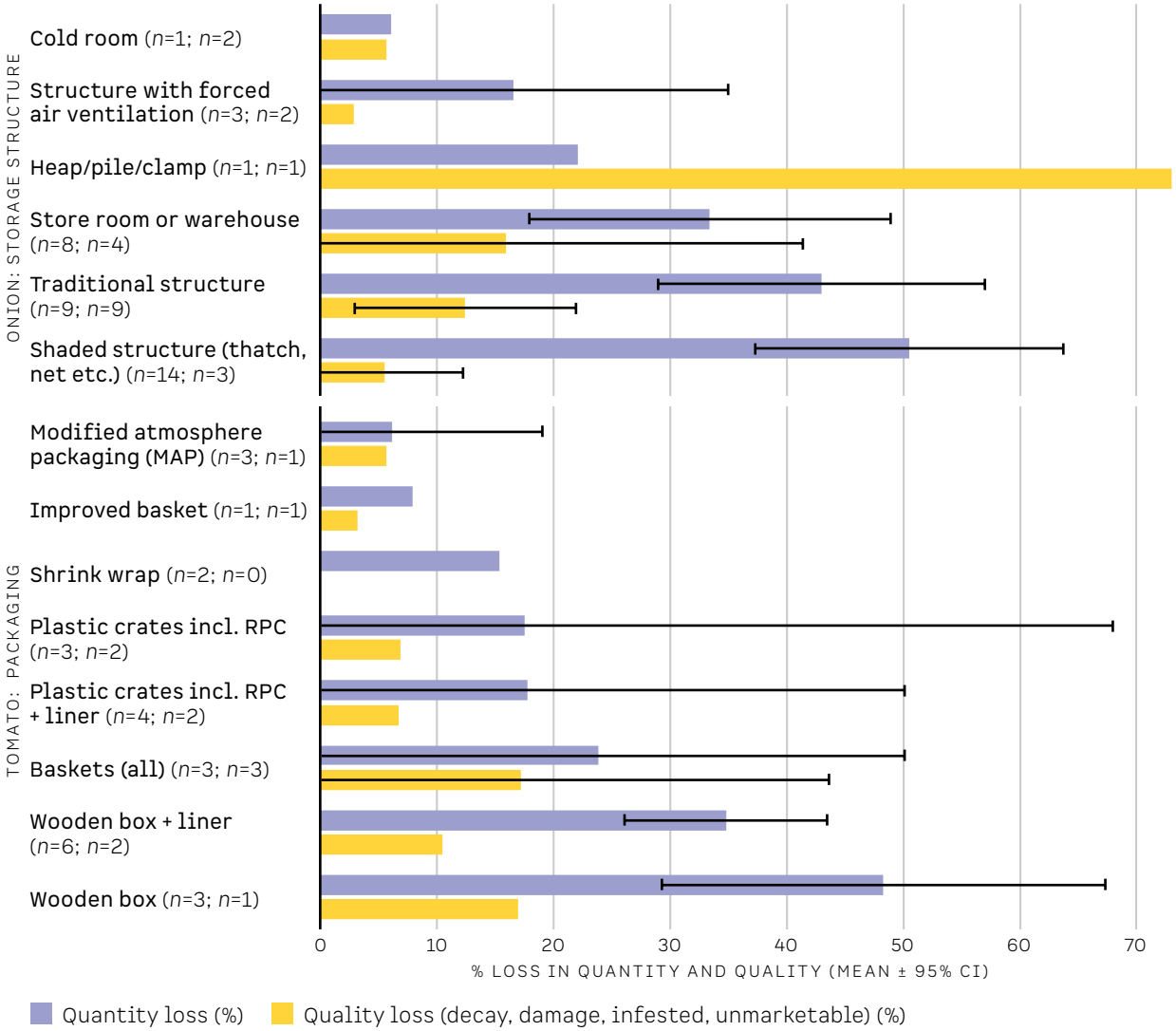
Training was conducted for 13,000 fishers, 16 markets were restored, 15 were constructed, and sanitation stations, water and electricity were provided to fish traders. In addition, 525 kilometres of roads were improved to ensure efficient transfer of goods. Market improvements meant less loss at markets during sales. They also improved the efficiency of markets. Local staff were trained to build and maintain infrastructure for storage facilities and markets to allow for a more sustainable transfer of project responsibilities from IFAD to the host communities.

Source: IFAD project completion report.

Improving on-farm post-harvest operations, storage structures and packaging methods

In many rural areas across the world, rural inhabitants have more food following the harvest period than later in the year. Food losses at the farm level due to poor storage facilities aggravate this see-saw of better and then inadequate nutrition throughout the year. But technologies and handling operations can reduce food losses (Stathers et al., 2020). For maize, using hermetic bags with synthetic protectant reduced losses – in weight and after a storage period of six months – to less than 5 per cent. In contrast, the use of jute sacks without protectant led to losses of almost 30 per cent. For onions (storage structure) and tomatoes (packaging), quantity and quality classifications are both relevant, while the ranges are considerable (**FIGURE 4.5** and **BOX 4.6**).

FIGURE 4.5 QUANTITY AND QUALITY LOSSES ASSOCIATED WITH DIFFERENT STORAGE STRUCTURES (FOR ONIONS) AND DIFFERENT PACKAGING (FOR TOMATOES)



Note: The first *n* indicates the number of examples of quantity loss data for this intervention, and the second *n* refers to examples of the quality loss data. RPC = Returnable plastic crates.
Source: Stathers et al., 2020.

BOX 4.6 FOOD LOSS IN PRACTICE: TWO CASE STUDIES FROM AFRICA

Tomatoes, grown in Burkina Faso, are transported in crates to the market in Kumasi, Ghana. Prevailing weather conditions, estimated using satellite meteorology, and information on the microclimate inside truck trailers were combined with data on the deterioration in tomato quality during transport, expressed by "firmness". A post-harvest loss model built on these estimates as input parameters explained 77 per cent of the variance in observed tomato firmness, with total product losses ranging from 30 per cent to 50 per cent over the entire transportation period. This can help to assess the cost-benefit ratio of various measures to reduce tomato quantity and quality loss – and to illustrate what net gains can be expected if delays along the transport route are reduced, cargo conditions are semi-controlled (for example, by pre-cooling) or a different transport schedule is adopted.

For teff and perishable liquid milk in Ethiopia's growing rural-urban midstream, losses were between 2 per cent and slightly over 4 per cent – a lot lower than commonly assumed. The emerging modern retail sector in Ethiopia has on average half the food losses of the traditional retail sector. This is probably due to more stringent quality requirements in procurement systems, sales of more heavily packaged – and thus better protected – commodities, and better refrigeration, storage and sales facilities.

Source: Venus et al., 2013; Minten, Tamru and Reardon, 2021.

Intervention choices should be linked to desirable outcomes

If the highest or most immediate priority is to change a particular food system outcome, this priority will inform the selection of interventions to reduce FLW (**FIGURE 4.6**).

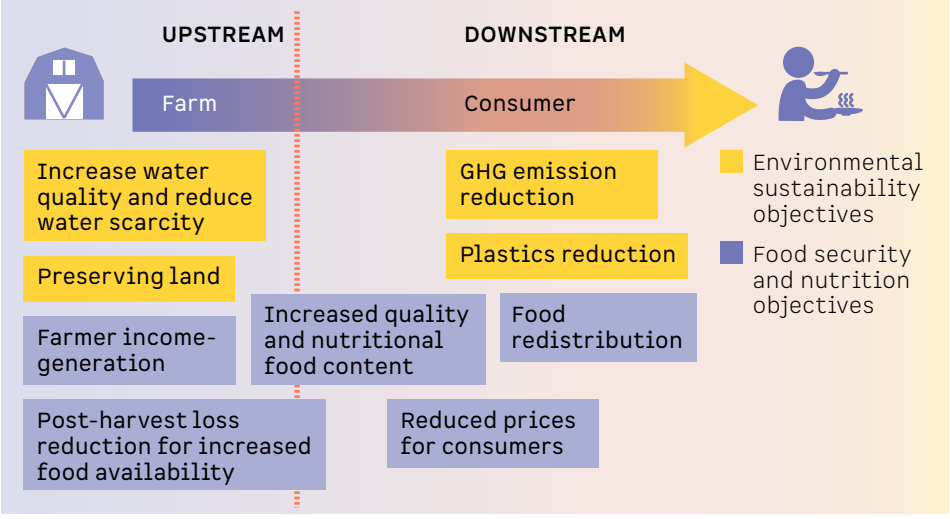
- For environmental outcomes, interventions may reflect the specific objective that is targeted. For example, because GHG emissions accumulate throughout the midstream, the most efficient way to reduce them is to reduce food waste by consumers – that is, the stage with the largest embedded GHG emissions. In contrast, if the objective is to preserve land and water quantity and quality, FLW should be cut in the primary production phase – the phase with the largest environmental footprint.
- For health and nutrition outcomes, the gains from cutting waste are at the farm level – where fewer losses mean increased food availability – and in the processing and retail stages, where food quality can be both increased and decreased.
- For livelihood outcomes, FLW-reduction initiatives should focus on the quantity and quality of production and price levels at points of sale, because these factors bear most directly on farmers' income. Cooling and road infrastructure and other post-harvest facilities are key to success at the market, particularly for perishables (**BOX 4.7** and **BOX 4.8**).

BOX 4.7 INFRASTRUCTURE AND STORAGE AS KEY CONSTRAINTS IN ADDRESSING FOOD LOSS AND WASTE

In the regional consultations among food system experts across IFAD regions, poor infrastructure and the lack of storage facilities were often mentioned as constraining factors in addressing food loss and waste. For example, one civil society respondent from the West and Central Africa region indicated that the quality of rural roads often slows down transport to consumer markets: "Transport from the countryside to the tarmac road, to the cities, where the population is with money, is still an issue. There are still a lot of mangoes, tomatoes and cabbages rotting on the field instead of being brought out." A private-sector respondent from the East and Southern Africa region indicated that the lack of the right storage infrastructure often limits the prevention of food loss and waste: "We are losing a lot before it even gets to the market because we don't have reliable storage. So we need proper storage facilities at the farm gate, we need the electricity so that we can preserve all these different horticultural products."

Source: Regional consultations.

FIGURE 4.6 ALIGNING OBJECTIVES AND INTERVENTION ENTRY POINTS ALONG THE FOOD SUPPLY CHAIN



Source: Torero Cullen, 2020.

As these distinctions imply, the FLW chain involves producer-consumer trade-offs. For example:

- In low-income countries, reducing on-farm losses may have strong positive food security effects for some farmers – but not for all – and for consumers. The loss reduction may especially benefit smallholder subsistence farmers by increasing the availability of food to them. But farmers who market part of their output may see drops in demand and price, with negative implications for their incomes and thus for their food security, as larger volumes cause prices to drop at later points in the supply chain. Such price drops benefit consumers.

BOX 4.8 SOLAR-POWERED MILK COOLERS FOR SMALLHOLDER DAIRY FARMERS IN ETHIOPIA

Researchers and private firms developed a small solar-powered milk cooler for smallholder dairy farmers to store their milk in 40-litre metal containers. Prototypes of this solar-powered milk cooler have spread to other countries in Africa, ranging from Tunisia to Uganda.

SOLAR-POWERED MILK COOLER IN ETHIOPIA

Photo source: Olga van der Valk, WUR/BOPinc. 3P4PPI Program.

- Reducing food waste by consumers is likely to improve food availability and access for the same consumers – yet the resulting reduction in consumer demand may leave farmers, and other supply chain actors, worse off.

Although these arguments provide general indications about which value chains to target for FLW-reduction interventions – given particular environmental, nutritional or livelihood objectives – evidence is lacking to relate FLW interventions to measurable social, economic and environmental outcomes.

Another question, often mentioned but understudied, is how FLW in the quantity and the quality of food crops may affect household food and nutrition security and income. More evidence is needed on the efficacy of FLW-reduction interventions in this area – especially when technical interventions are combined with non-technical interventions, such as changes in training and handling practices. Such evidence is also important to deepen understanding of the combined effects of financial, policy and infrastructure interventions and encourage more participatory learning approaches on nutrition and food security.

Reducing food loss and waste may have benefits and costs – and mixed effects on employment opportunities

Post-harvest loss reduction is not always the most cost-effective route to inclusive and sustainable food system transformation (Sheahan and Barrett, 2017). Quality loss and food safety issues have not been studied as much as quantity losses. Nor is the evidence for venturing into massive food loss-reduction programmes as strong as in the case of urban solid waste in Bangladesh (Ananno et al., 2021) and Africa (Loukil and Rouached, 2020).

In summary, two FLW agenda issues – the extent to which interventions on food losses have been effective and how much can consequently be recycled back into the food system – remain open for discussion (Torero Cullen, 2021). The answers depend greatly on the objective and on which segments of the value chain are addressed, while food loss-reduction activities have winners and losers. Largely unanswered, too, is the question of whether evidence exists for sustainable reductions in FLW and for (gender-sensitive) employment creation through FLW interventions and incentives.

How well can household waste be recycled in food systems?

Household residues consist of solid biological waste, liquid excreta, recyclable materials and non-biodegradable waste (**BOX 4.9**). Household waste and human excreta are important sources of nutrients and energy for improving food systems; loss of these resources can be reduced with appropriate incentives, and lost resources can be recovered with sound community organization.

There is a non-linear relationship between per capita income and the share of food wasted in different parts of the world (Barrera and Hertel, 2020). As a result, household uneaten calories are growing rapidly – especially in emerging economies – and may nearly double by 2050 (**FIGURE 4.7**).[6]

BOX 4.9 HOUSEHOLD RESIDUES

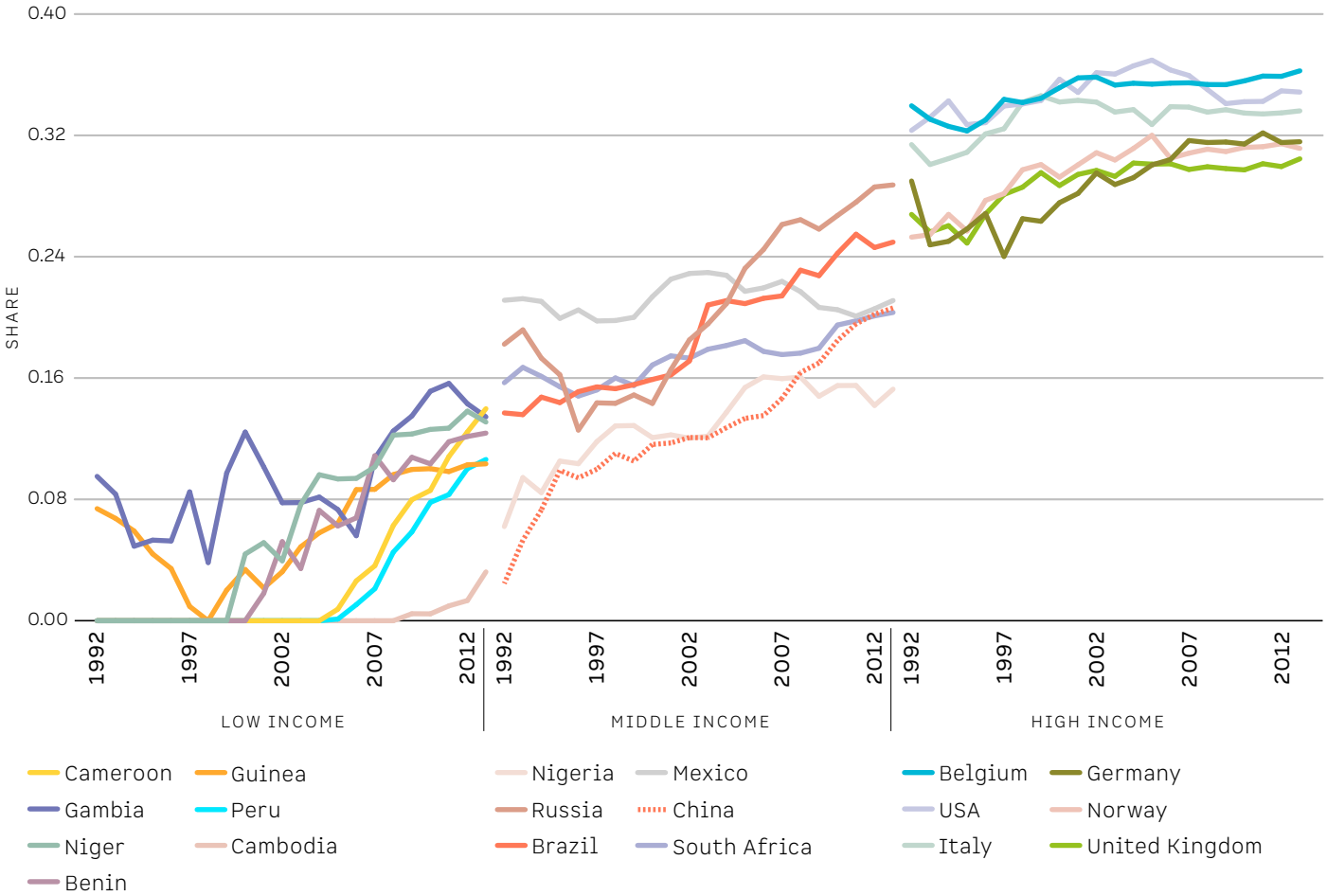
Household residues fall into four types:

- **Solid waste:** food leftovers, waste fruits and vegetables that originate from households and markets. Much of this results from packaging materials (e.g. banana leaves, grasses and potato stalks) used for wrapping fresh foodstuffs, as well as from leftover products that can no longer be sold or consumed.
- **Recyclable material:** includes paper, glass, plastics, metal and textiles. A fraction of this waste can be salvaged and directly recycled for making secondary materials.
- **Non-biodegradable waste:** waste materials that can be harmful or toxic to humans. This includes, for instance, construction and demolition waste.
- **Solid and liquid human excreta:** largely sourced from households, educational institutes and other common facilities that use latrines.

Source: Authors' elaboration based on Gustavsson et al., 2011, and Irani et al., 2018.

6 In sub-Saharan Africa and South and South-East Asia a decade ago, food waste at the consumer level (household and retail) was estimated at 6-11 kilograms per person per year (Gustavsson et al., 2011).

FIGURE 4.7 SHARE OF FOOD WASTE ACROSS THE INCOME SPECTRUM



Note: The share of food waste is calculated as the ratio between calories wasted in relation to calories available.
Source: Barrera and Hertel, 2020.

On the rural-urban continuum, urban residents throw away more food waste than do their peri-urban and rural counterparts – even when they have better cold-storage facilities (Loukil and Rouached, 2020). Low-income households and ethnic minorities are presumed to waste less food than wealthier households (Loukil and Rouached, 2020). Households throw away greater quantities of unprepared food than prepared food and drinks (Chakona and Shackleton, 2017).

Involving households in waste recovery strategies

Household food waste is mainly a result of consumer behaviour related to food preparation and storage. Reducing household food waste requires integrated food management that includes shopping, storing (including cold storage) and appropriate cooking and eating practices. Awareness and educational campaigns can provide incentives for household food waste reduction (van Geffen, van Herpen and van Trijp, 2020).

Dietary transitions typically involve increased consumption of foods with a shorter shelf life – such as dairy, fruits and vegetables – and this shift may increase food waste in the absence of efficient storage options (Lundqvist, de Fraiture and Molden, 2008). About a quarter of household food waste could be reduced with appropriate packaging (Williams et al., 2012).

Residential waste and human excreta are valuable resources for recycling, and their collection and treatment is motivated mainly by environmental and health concerns

Residential waste comprises disposable materials that are generated in day-to-day operations by households and that can be recycled or composted for secondary use. Waste collection, excreta disposal and wastewater sewage are vital for environmental safety and human health. Getting appropriate systems in place for organized waste recovery at scale requires local organization, community collection and treatment services (public or private) and some degree of collective action (Sugihara, 2020).

Sanitation for low-income residential areas relies mostly on pit latrines and bucket latrines. These latrine types enable sludge and night soil to be collected, transported and used for final treatment and disposal. In Asia, cleaners of latrines are often a special social or ethnic group and face dangerous labour conditions and low pay. Along the East African coast, where Islamic influence is strong, people are averse to touching human excreta (Muller, 1997).

Some 4 billion litres of untreated wastewater is created each day in developing countries. Wastewater treatment serves three purposes: improving local health conditions, reducing environmental externalities and recovering nutrients. Untreated wastewater directly contributes to diarrhoeal diseases, such as cholera, typhoid fever and rotavirus, which are annually responsible for 297,000 deaths of children under 5 years old – 800 children every day (The Lancet, 2012). An estimated 80 per cent of wastewater from developing countries flows untreated into the environment (The Conversation, 2021).

The organization of waste recovery and excreta disposal should be undertaken by public, private or community organizations and supported by economic and social motivation mechanisms

A wide range of technological opportunities and innovation strategies are available to better link the producers of waste and excreta in urban and peri-urban households to the potential users of recycled products in rural and urban livelihoods. Waste and excreta are used for different purposes, ranging from energy (cooking and heating) to the organic fertilization of homestead vegetable production.

Recycling and reusing household residues requires efficiently organized collection and treatment processes at the neighbourhood and village level in order to guarantee volume (scale), velocity and safety. Africa currently recycles

only 4 per cent of its waste, and more than 90 per cent is disposed of in uncontrolled dumpsites and landfills. In Asia, much of the collection is done by local associations, although in larger agglomerations publicly organized municipal waste services are in charge.

The main strategies for tackling food waste include:

- Sharing information and knowledge among stakeholders.
- Broad legislation for better packaging.
- Circular, rather than linear, solutions, for food waste reduction that rely on multi-stakeholder collaboration – especially public-private partnerships (Irani et al., 2018).

Food waste policies are strongly influenced by non-state actors in communities and households. Yet the decentralization, privatization and devolution of food waste governance to local institutions may be less effective in reducing food waste.

This chapter has focused on rescuing and reusing organic carbon and nutrients in soils, in products, in markets (including informal street markets), in distribution centres for supermarkets and in rural and urban households. The longevity of the product is determined to a great extent by packaging and storage technologies (Stathers et al., 2020). But the more packaging is used, the more materials that will not easily decompose and may burden the environment are used. Bans on plastics through legislation are increasingly common in developed and developing countries alike, and allude to growing circular systems thinking. This is, however, an environmental issue that is far from solved and in need of innovation and investment.

Can biobased foods, feed and plastics replace fossil fuel-based ones?

Recent innovations suggest that feedstocks for biobased products can be produced from renewable raw materials – biomass, waste, CO_2, and so on – rather than from fossil fuels. Such a green shift to biobased products could alleviate economic, ecological and societal problems worldwide.

A visionary path forward would be to achieve full recycling of CO_2 while using other renewable sources, such as waste and biomass. This approach could open a new chapter in the circular economy – using CO_2 from a broad range of sources and offering a variety of biobased platform chemicals and solvents. Yet full CO_2 recycling will require significant research and development, and further investments will be needed to make the technology ready to use (Venkata Mohan et al., 2016).

Knowledge is growing on how biotechnology applications can support circular food and energy systems. Offshore cultivation of seaweed in Denmark provides an innovative feedstock for biobased products (Seghetta et al., 2017). First, the anaerobic digestion of seaweed produces energy, which is converted

BOX 4.10 RENEWABLE ENERGY TECHNOLOGIES

Global energy use dropped nearly 6 per cent in 2020, primarily due to COVID-19, but this reduction and the subsequent drop in CO_2 emissions will not be enough to satisfy the Paris Agreement climate targets. In addition, 770 million people remain without access to electricity, and more than 2.6 billion people continue to rely on the traditional energy sources of solid biomass for cooking – releasing additional CO_2 and causing about 2.5 million deaths annually. Continued investment in renewable energies must accelerate the transition towards low-carbon outputs while simultaneously providing better and more sustainable livelihoods for rural people.

The potential for scaling up and implementing renewable energy technologies is greatest at the household level and provides opportunities for improved processing of agricultural products by domestic enterprises. Through the Adaptation for Smallholder Agriculture Programme, IFAD has supported the expansion of renewable energy technologies through projects in India, Kyrgyzstan, Mozambique and Rwanda through cooking stoves, biogas digesters and solar-powered pumping systems. Pay-as-you-go and energy-as-a-service models have helped people in Madagascar and Rwanda improve their quality of life and conduct business in an efficient, environmentally friendly manner.

Source: IEA, 2020; IFAD 2020.

For more information, see https://www.iea.org/articles/global-energy-review-co2-emissions-in-2020, https://www.iea.org/reports/sdg7-data-and-projections/access-to-electricity; https://www.iea.org/reports/sdg7-data-and-projections/access-to-clean-cooking; https://www.ifad.org/en/renewable-energy; and https://www.ifad.org/documents/38714170/40306309/REF_LL_web.pdf/e533399b-3f1d-4da3-82ca-16321d0bc38d.

into biogas for electricity and heat production – along with digestate, which can be used as fertilizer. Second, the seaweed produces proteins through the use of seaweed hydrolysate as a substrate for cultivating heterotrophic microalgae. Positive results include a reduction in GHG emissions and mitigation of coastal water eutrophication. But the technology also entails a risk: bringing seawater arsenic into the food cycle.

In another biotechnology development, conventional petroleum-based polymers can be replaced with algae-based biopolymers. The benefits of microalgae biopolymer over other feedstock include its autotrophic complex (reducing GHG emissions), its ability to compost (providing GHG credits) and its rapid growth and adaptability to diverse environments (Devadas et al., 2021).

Plant-based materials also play a part in transitioning to a circular economy. Bioplastics, though a growing industry, account for less than 1 per cent of all plastic production. Cellulose and starch are abundant, widely available plant polymers used extensively for paper, packaging, food service items, bags and biofuels. The growing use of plant-based materials will have environmental benefits: reducing waste, lowering GHG emissions, promoting rural investment, reducing the volume of harmful pollutants, conserving ecosystems and biodiversity, and supporting the transition to a circular economy (Shogren et al., 2019).

The promise of biobased solutions lies in:

- Replacing fossil fuel-driven production with circular systems based on biological sources, leading to vast environmental benefits and employment opportunities.
- Introducing untapped resources into the food chain, relieving pressure on existing food systems.
- Producing materials that, being biodegradable, will never be "wasted" for environmental use.

Policy priorities for circular agrifood systems

To shape circular agrifood systems and support the biobased economy outlined in this chapter, policymakers must focus on developing and promoting technologies, resource use practices and policy incentives that enable stakeholders to reduce, reuse and recycle food losses, waste and residues in order to enhance the efficiency, sustainability and diversity of food systems.

Specifically, policymakers should:

1. **Facilitate the transition from linear to circular food systems** through a basket-of-options approach.
2. **Support nutrient recycling in production and food systems with knowledge development**, innovation programmes and market-support measures.
3. **Reduce food losses based on the objective of doing so**, and on product group and value chain segment, by combining focused technical interventions with increased services for agrologistics, finance and training, bearing in mind that the evidence base is still shaky.
4. **Enable waste recovery from food and excreta in households and neighbourhoods** through a combination of awareness-raising, public or private collection services and behaviour change incentives, within the boundaries of food safety and public health.

Simulation 4 in annex 1 illustrates how halving farm gate food losses, against a business-as-usual baseline, has mixed prospects for inclusiveness, improves nutrition and has modest effects on sustainability.

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PART C

The food system midstream

Supporting small-scale enterprise and entrepreneurship in the midstream and on the farm is essential for unlocking inclusive economic opportunities in the food system. Chapter 5 focuses on how trade and markets can be transformed into a driver rather than an obstacle for inclusive and sustainable food systems, exploring trade-offs between trade openness and food system resilience and describing the role of standards compliance and the incorporation of externalities into trade regimes. To overcome the potential trade-offs between trade openness and desired food system outcomes, policymakers should focus on four priorities. They should enhance resilience to external shocks through the diversification of both production and markets. They should enhance competitiveness and improve market access for local farmers and small and medium-sized enterprises (SMEs). They should develop grades and standards, which are critical to support inclusive food systems. And they should incorporate social and environmental externalities and reinforce non-market values in trade regimes.

Chapter 6 shows how the ongoing expansion and transformation of SMEs in the midstream of food systems can contribute to livelihoods, food quality, safety and diversity, as well as provide market linkages for sustainable agricultural production. While linking smallholder farmers to both input and output markets, the midstream segment also creates employment and income opportunities outside primary production, particularly for women and youth. Policymakers should enable midstream SMEs to raise agricultural productivity. They should facilitate midstream SMEs in contributing to food quality and diet diversity. They should improve labour market functioning

and the business climate. They should provide market incentives for SME investments to strengthen more circular and sustainable food systems. They should enhance midstream contributions for food system sustainability. They should base supply chain governance on social norms, public policies and private investment. And they should support the "hidden middle" of midstream agrifood enterprises to fill the "missing middle" in agrifood support services. Beyond improved access to material services, shared norms – for the establishment of mutual trust, reliable transactions and transparent relationships – are critical to reduce risks of collusion and exclusion. Food system transformations will only succeed if SMEs can overcome discriminatory norms and practices.

Chapter 7 looks at how food processing, and especially local food processing, can contribute responsibly to livelihoods and nutrition. As people become more urban and incomes rise, processed foods make up a growing share of diets. This evolution has some positive effects: food processing can contribute to better food safety and higher food quality. But it can also have negative effects: because more processed foods are convenient and are often less expensive, people are tempted to consume them in excess. Such overconsumption – especially of ultra-processed food (UPF) – drives up health risks, increasing the incidence of overweight and obesity. To support healthy, inclusive and sustainable food processing, policymakers should facilitate small-scale local food processing industries that provide new bottom-of-the-pyramid business and employment opportunities – especially for women and youth – and increase access to a wider variety of food products. They should also support the moderate intake of processed foods and UPF with incentives for responsible business innovation processes and with standard-setting facilities for the food environment. And they should support a conducive food environment, based on clear guidance rules and behavioural change communication to moderate UPF intake by disadvantaged groups and prevent excessive UPF intake, especially through self-regulation by firms engaged in UPF supply and marketing.

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CHAPTER 5
Driving trade and markets for inclusive and sustainable food systems

Trade creates challenges as well as opportunities for food systems. Around the world, most food is still domestically produced. Yet recent decades have seen food markets become increasingly global. While trade can improve food access and affordability in less developed countries, these positive effects are not always self-evident or predominant. Open trade can constrain the potential for local food production by lowering prices and putting higher pressure on local farmers. A rise in food import dependency can expose consumers to external shocks in food availability and discourage the integration of domestic value chains.

Must these concerns mean that trade – the emergence of international competition and the evolution of global food and agriculture value chains – is an enemy to inclusive, efficient and sustainable food systems? No. Despite the legitimate concerns, the benefits of trade for food security remain substantial. In addition, international trade can balance regional differences in climate change impacts and biodiversity. Trade is thus a potential adaptation mechanism (Janssens et al., 2020). Yet international standards can be daunting for less developed countries seeking to expand their trade in agricultural commodities and food products.

This chapter develops four messages:

1. **Trade-offs between trade openness and food system resilience must be overcome.** While trade has been a huge force in increasing food availability around the world, it can also pose threats to food security by increasing indebtedness and making food supplies more vulnerable to shocks – always at the expense of poor producers and consumers. For countries with economies dominated by the agricultural sector, two important strategies to increase resilience to external shocks are to diversify food production and the composition of food trade and to integrate regional markets to develop comparative advantages in food production.

2. **Market and trade policies drive improvements in domestic agriculture and food security.** Governments should enhance the agrifood sector's competitiveness by creating a stable market environment and improving market access opportunities. The opportunities for public intervention in aligning food systems with international trade opportunities differ widely between small and large countries – and also depend on the degree of food system development and international market integration.
3. **Low-income countries must reinforce standards compliance for products they are competitive in supplying to fully realize the benefits from trade.** Because production and international trade are increasingly regulated by standards (whether voluntary or compulsory), low-income countries must ensure trade complies with these standards. But grades and standards can easily become a barrier to trade, requiring substantial investments in equipment, vocational training and support services before compliance and control can be enforced. So focusing on the most competitive products is essential.
4. **Trade policies need to incorporate critical externalities and reinforce non-market values.** Trading systems are bound by regulations and standards that often do not incorporate such non-market values as food safety, environmental quality, nutritional content and decent labour conditions. To support environmentally sustainable, nutritionally beneficial, safe and inclusive food systems, countries should pursue trade agreements that reinforce these non-market values.

Overcoming trade-offs between open trade and resilient food systems

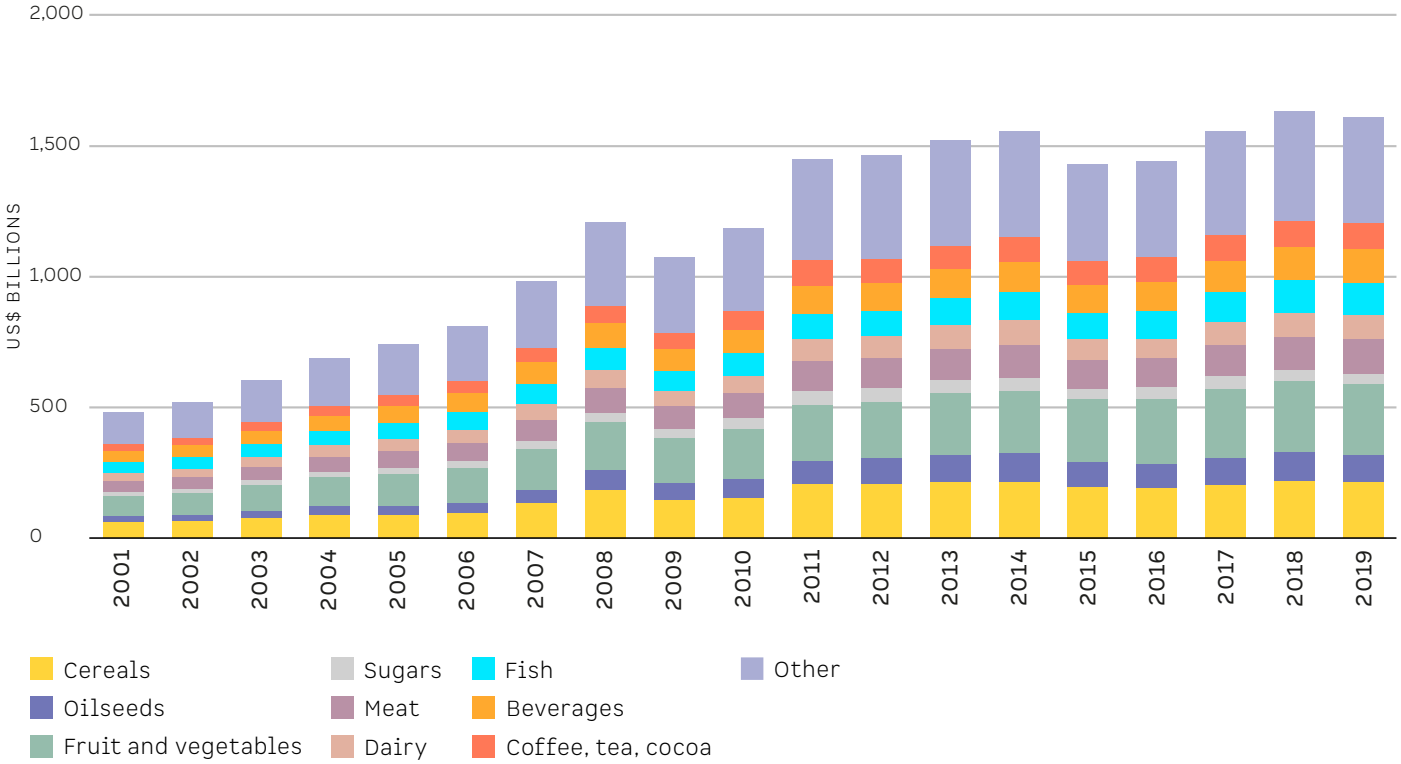
During the past half century, as global agricultural production tripled, trade in agricultural commodities and food products increased eightfold – with an acceleration in growth in the past two decades (**FIGURE 5.1**). Even though the majority of food produced around the world is consumed domestically, trade increasingly contributes to feeding the world's people.

To achieve inclusive and sustainable growth, the socio-economic and environmental trade-offs of international trade must be systematically assessed, confronted and reduced. Despite trade's positive association with food security, it could also make low-income food-deficit countries more dependent on food imports – putting local producers under uneven competitive pressures and making consumers more vulnerable to external shocks in food availability (Koning and Pinstrup-Anderson, 2007; De Schutter, 2011; Hepburn, 2019).

These dynamics are reflected in the responses to the regional survey conducted for this report. Respondents considered market dynamics the most important driver of food affordability, and access to markets is seen as an important driver of both low income levels and food availability.

FIGURE 5.1 DEVELOPMENT OF GLOBAL TRADE IN AGRIFOOD PRODUCTS

WORLD IMPORTS OF AGRIFOOD PRODUCTS



Source: International Trade Centre.

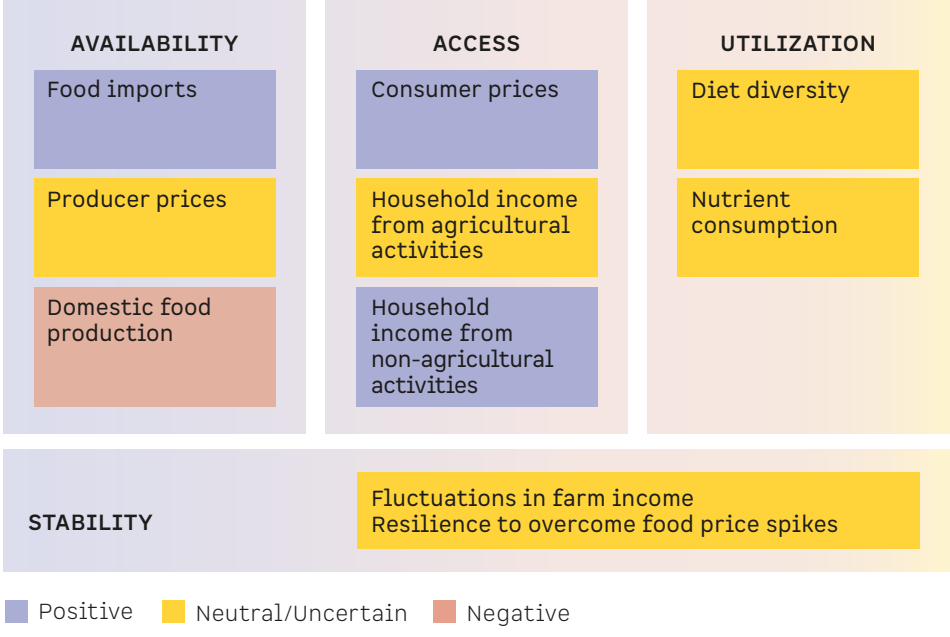
How can less economically developed countries increase resilience to external shocks in agricultural and food markets? One vital strategy is the diversification of national economies. Another key strategy is regional market integration, which allows regions to exploit comparative advantages in food production.

Benefits and trade-offs of trade openness

International trade has a broadly positive association with all four dimensions of food security: availability, access, utilization and stability. Yet the configuration of international trade varies considerably across countries, as does the domestic macroeconomic environment. For some countries, food trade can also have some neutral or uncertain effects on each dimension of food security – and on one, food availability, it can have partly negative effects by reducing domestic producer prices (**FIGURE 5.2**). Accordingly, international trade comes with complex trade-offs that need to be addressed through a decisive package of policies.

Because of the complex potential effects, the net impact of international trade and food systems – and of policies to boost trade even further – is uncertain and dependent on local conditions. Some specific areas where problems can arise are as follows:

FIGURE 5.2 HOW INTERNATIONAL TRADE AFFECTS THE FOUR DIMENSIONS OF FOOD SECURITY IN FOOD-DEFICIT COUNTRIES



Source: van Berkum, 2021.

- **Trade may reduce food availability in low-income food-deficit countries.** Despite the widely acknowledged links between increased trade and improved food security, trade can pose challenges to food systems in low-income food-deficit countries, where increased trade brings a risk of higher dependence on food imports – putting local producers under growing competitive pressure, and making consumers more vulnerable to external shocks in food availability.
- **Trade may drive the adoption of unhealthy diets.** Increased access to cheaper, more diversified food through open trade may not necessarily improve the nutritional quality of diets. Because as trade openness drives nutritional transitions (CHAPTER 1), it can also increase access to unhealthy food and thus drive overweight and obesity (GLOPAN, 2020).
- **Trade may not always support stability in food markets.** Recent international price spikes – in 2007/2008 and 2011/2012 – have cast into doubt the assumption that trade openness makes food markets more stable.

Some of these issues can be overcome by macroeconomic policies (**BOX 5.1**).

Respondents in our regional survey considered market dynamics the most important driver of food affordability, and access to markets is seen as an important driver of both low income levels and food availability.

BOX 5.1 MACROECONOMIC FACTORS AFFECTING FOOD SECURITY

Trade alone cannot solve food security problems, for economic development drives food security. But macroeconomic factors can influence the four components of food security through different channels (Diaz-Bonilla, 2013, 2015). Government revenues could also support food security policies and investments, such as research and development (affecting availability and stability), basic health services, and food assistance and social protection programmes (affecting use and nutrition). Nutrient security pertains mostly to the individual but is largely affected by income and factors that determine access to food (Global Panel on Agriculture and Food Systems for Nutrition (GLOPAN) Summit 2017; GLOPAN, 2020). From this perspective, actions that affect non-agricultural markets and employment – such as building infrastructure or ensuring equitable access to education – could be just as important for food and nutrition security as policies and investments in the agrifood sector.

This means that discussions of trade and food security need to be placed in the context of an overall framework of macroeconomic transformation and exchange rate policies (Diaz-Bonilla, 2015; OECD, 2019).

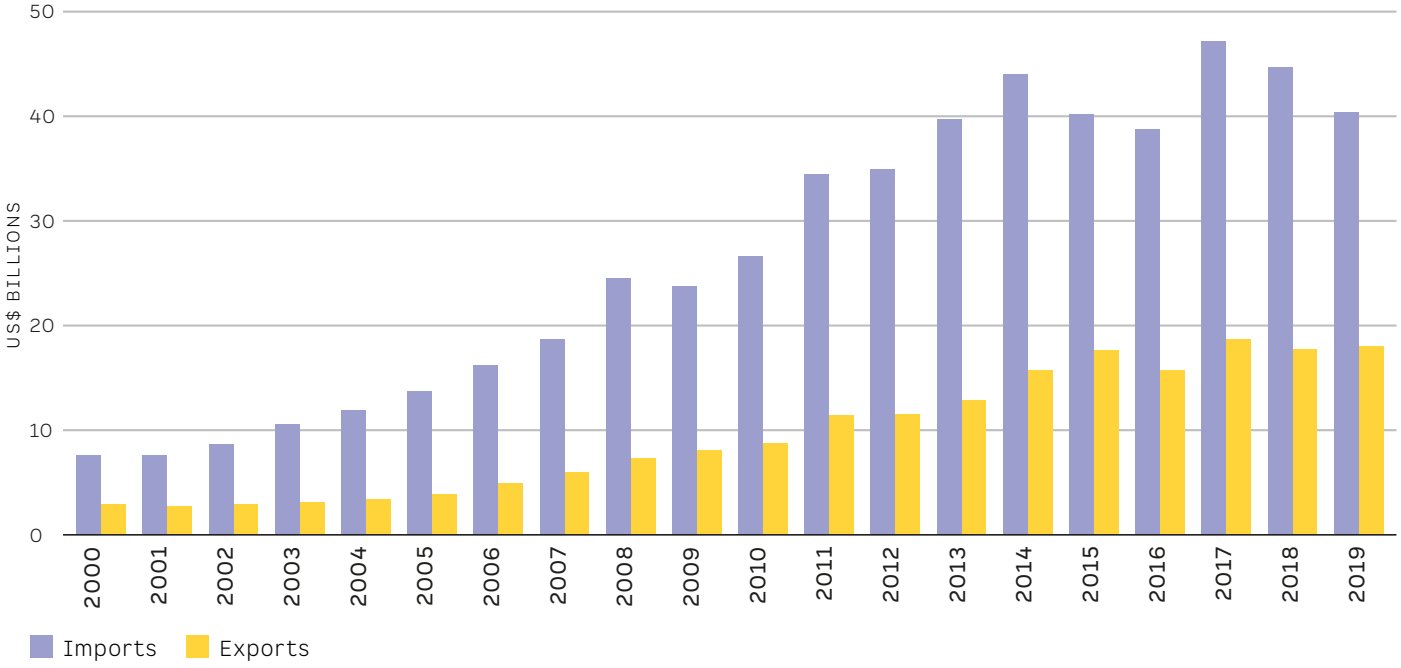
How can efforts towards inclusive food system transformation address these trade-offs, even if they cannot wholly eliminate them? Countries that depend heavily on food imports need policy and investment strategies that reduce the propagation of international shocks to local food markets – without losing the potential benefits of open markets. Such policies and investments aim to make a country's agrifood sector more competitive while enhancing national food security, two objectives that can be reconciled only through trade-compliant domestic policies that also support inclusive and sustainable value chains.

Low-income countries must reduce food import dependence by diversifying supply, exports and trade partners

The least developed countries, as a group, increasingly depend on food imports. Over the past two decades, their combined annual imports of agricultural and food products have risen more than fivefold – from US$8.7 billion in 2000 to around US$50 billion in 2017-2019 (FAOSTAT). As exports have risen more slowly, the least developed countries' joint agricultural product trade deficit has substantially increased: since 2011 it has exceeded US$20 billion, and it reached US$29 billion in 2017-2018 before falling back to US$23 billion in 2019 (**FIGURE 5.3**).

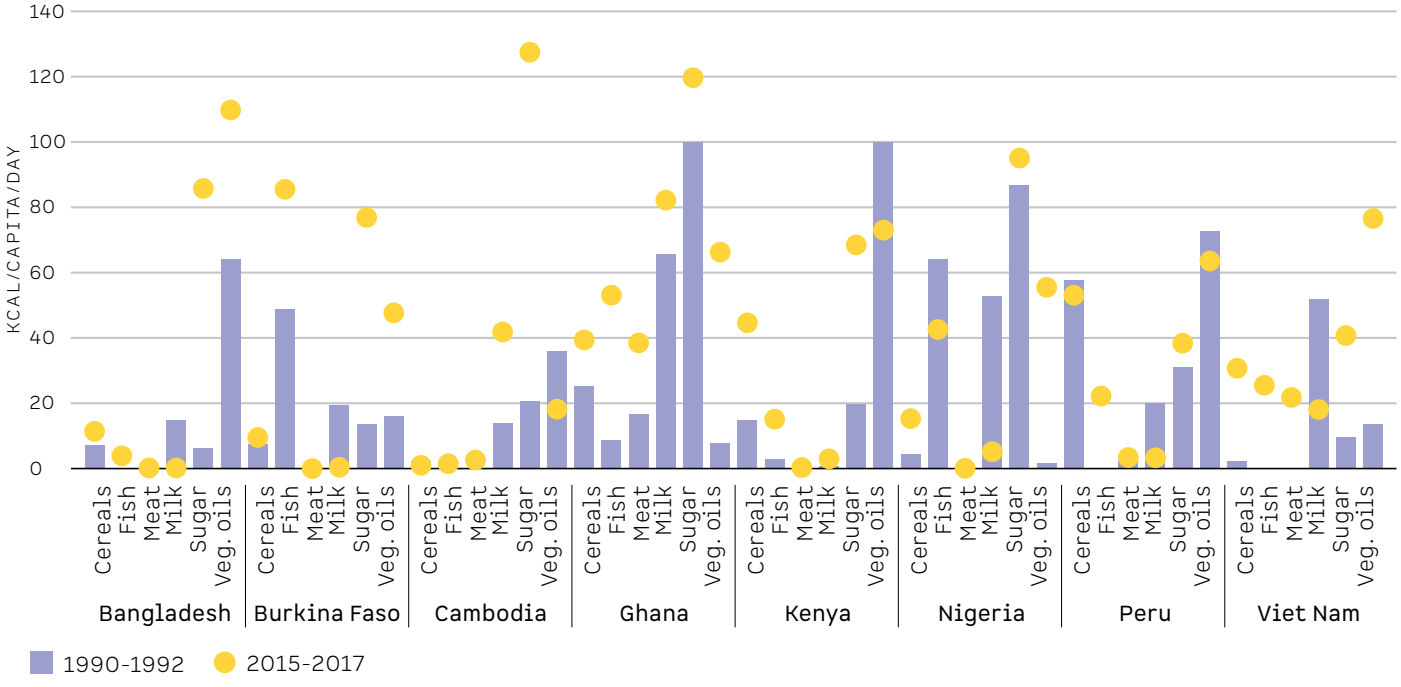
For a number of low-income countries, rising imports have led to higher import dependency over the past three decades. But because markets for different products are changing in various directions, countries face a range of net trade positions and food import dependencies that evolve differently over time. These more complex dynamics do not appear in the aggregated totals shown in **FIGURE 5.3**. Variations in trade positions across food products for eight countries are displayed in **FIGURE 5.4** (see also AGRA [2020] on country and regional developments in Africa).

FIGURE 5.3 LEAST DEVELOPED COUNTRY EXPORTS AND IMPORTS OF AGRICULTURAL PRODUCTS, 2000-2019



Source: FAOSTAT data on crops and livestock products trade.

FIGURE 5.4 SHARE OF IMPORTS IN DOMESTIC FOOD SUPPLY IN SELECTED LOW- AND MIDDLE-INCOME COUNTRIES



Note: Food balance sheet (FBS) imports in tonnes are converted to kcal/capita/day based on the ratio between the FBS food supply in tonnes and the FBS food supply in kcal/capita/day. For some products, percentages of imports are above 100, which means that production (and stocks) are very low and the country mainly imports this product but there are also some exports, which brings domestic supply available below the level of imports.

Source: Food and Agriculture Organization of the United Nations Food Balance Sheets.

Regions and countries with both high import reliance and low domestic food availability face specific challenges to the stability of their food supply. High import dependency easily creates food security risks, as harvest failures affecting foreign suppliers and policy changes can cause supplies and prices to fluctuate. The chances of supply disruption are further increased if the importing country depends on just one or two suppliers – which is often the case with commodities such as wheat, rice, palm oil and soybean, where the concentration of exporters is high (OECD and FAO, 2019; ITC, 2020). Diversifying supply sources is thus an important additional strategy for reducing risks to food security.

Food import dependency becomes severe when countries are less able to finance food imports – a risk that is highest if a country's economy depends heavily on commodity exports or imports. For 129 low- and middle-income countries, high export and import dependence on primary commodities had a statistically significant and negative effect on food security over 1995-2017 (FAO et al., 2019). Moreover, 80 per cent of the countries that saw a rise in hunger during recent economic slowdowns have economies that are highly dependent on primary export or import commodities (or both).

Evidence from several African countries shows that past commodity price shocks seriously affected food and nutrition security, as households saw a decline in purchasing power – the result of income declines and job losses caused by currency devaluation and public spending cuts (FAO et al., 2019, 2020).

Countries that depend heavily on export commodities such as coffee, cocoa, tea, palm oil or rice may face food security risks from a deterioration in those products' terms of trade. In this case, it is vital to promote commodity and market diversification, say by focusing on added value creation. But because most low-income countries have undeveloped processing industries, substantial investments are required for value addition. Where trade dependency is mainly related to import demand, diversifying domestic food production – in areas where this is feasible – may be the required approach. But such structural transformations must also be pro-poor and inclusive.

From an extensive analysis of export diversification options in Chad, Guinea, Mali and Niger, López-Cálix (2020) identifies key elements for simultaneously reinforcing market infrastructure (hardware) and market exchange conditions (software). Targeted investments are needed in market infrastructure for efficient logistics. Also needed are targeted investments in human capital to build skills that enhance people's productivity and employability. And government interventions must reduce specific institutional deficiencies, such as a lack of information and knowledge about market standards.

Small-scale farmers, especially if they are resource-poor, face many obstacles to commercializing and diversifying their supply (CHAPTER 3). For instance, the opportunities of small-scale producers in India to diversify in response to an increasing demand for more nutritious foods, such as fruits, vegetables and pulses, met several major barriers, including the high cost of

access to inputs, information, capital and technology (Pingali et al., 2019). India's experience shows that producer organizations and cooperatives – in which smallholders organize themselves in groups to jointly access resources and market their produce – can reduce and mitigate market entry transaction costs for smallholders and help them form market linkages.

Trade can increase local food availability and improve food access by lowering prices – yet these changes do not necessarily benefit the people with the greatest need. In low-income food-deficit countries, where the livelihoods of poor people typically depend on low-productivity agriculture, the positive effects of better access to more food may be offset by the negative effects of higher imports of agricultural inputs and declining producer prices and farmer incomes. Among 52 developing countries, net food-importing countries with a large share of livelihoods in the agricultural sector had opened to food trade, effectively increasing food supply – but per capita GDP in the food sector declined, causing an overall rise in undernutrition (Mary, 2019).

Countries that face net negative welfare impacts from greater trade openness and food imports could potentially mitigate these effects by reforming food systems. Though often used, border measures – such as import tariffs and quotas – are not the best instrument for this purpose (Brooks and Matthews, 2015; Martin and Laborde, 2018). While tariffs may encourage farmers to increase production in response to a tariff-driven rise in prices, they can also make food more expensive for consumers. Moreover, protectionist trade measures, together with input subsidy programmes, tend to incentivize domestic production of staple foods such as rice and maize, often to the detriment of vitamin- and micronutrient-rich foods (fruits and vegetables), thus increasing the affordability of more nutritious foods (FAO et al., 2020). Support for one constituency thus comes at the expense of another – and smallholder families may be harmed too, if they are net buyers of food.

The choice of trade policy priorities thus has decisive implications for domestic income distribution and plays a key role in overcoming trade-offs between different food system transformation objectives (**BOX 5.2**). This choice is also highly dependent on the role of the domestic agricultural sector in the national economy.

BOX 5.2 GOING LOCAL FOR INCREASED FOOD SECURITY AND SUSTAINABLE PRODUCTION SYSTEMS?

The outbreak of COVID-19 and its spread around the world in early 2020 disrupted international food trade chains through travel and transportation restrictions. Concerns about sufficient food led several countries to close borders to ensure domestic food security. In many cases, this did not take long, mainly because global food supplies turned out to be sufficient and the major exporters of food staples imposed no restrictions (IFPRI, 2020; WTO, 2020). That the number of poor people with acute food insecurity is expected to have increased by about 270 million in 2020 is mainly a result of income drop due to spiralling unemployment and economic disruption caused by COVID-19, not because too little food is available (World Bank, 2021).

Even so, the pandemic fuels discussions about the advantages of local food production over dependence on international chains. Local food purchases in short food value chains tend to have a spillover effect on the community that is generally positive. But food prices are often higher than when foreign competitors enter the market, and the diversity in diets that consumers want is often difficult to meet with only local produce. Trade restrictions to promote local production could therefore have a negative impact on food access and utilization.

Moreover, there is little evidence that locally produced foods have a lower ecological footprint or less negative ethical or social impact than imported food. Those impacts depend on how the food is grown, raised, caught and distributed (Edward-Jones et al., 2008; Vidergar, Perc and Lukman, 2021). Eating locally would have a significant positive environmental impact only if transport is responsible for a large share of food's final carbon footprint. For most foods, this is not the case (Dalin, 2016; Poore and Nemecek, 2018). To reduce the carbon footprint of food, the focus should be on what people eat, not on whether the food is local.

Stronger regional trade relations can increase regional specialization and food security

Across Africa, promising opportunities exist for boosting intraregional trade in agricultural and industrial products and services (World Bank, 2012; ODI, 2013; FAO, 2016; AGRA, 2019; Andam et al., 2019). Generally, regional trade agreements and market integration strategies can be an engine of growth, as in Europe, North America and South-East Asia. Yet regional trade within the Africa region is still fairly limited: less than 20 per cent of all exports. One reason may be that existing regional trade agreements, such as the Common Market for Eastern and Southern Africa (COMESA), the East African Community (EAC) and the Southern Africa Development Community (SADC), frequently exclude free trade in foods, because their product portfolio is rather similar and countries consider each other competitors.

As population growth, income growth and urbanization drive rising food demand and dietary diversity in African countries, new initiatives to reduce intraregional trade barriers show great economic potential. The recently established African Continental Free Trade Area (AfCFTA) may stimulate intra-Africa trade, accelerate export diversification, and diversify export destinations and types of goods produced in the region (Brookings, 2019). It promises to increase intraregional trade in food products, which, if accompanied by the right measures, can greatly boost smallholder farmers' productivity growth and prospects for integrating into food value chains (AGRA, 2020; UNECA, 2020).

To make the most of these new opportunities, governments in Africa will need to reduce transaction costs by improving trade facilitation – such as import customs clearance procedures and port handling at the border – and to invest in physical infrastructure, including roads, railway tracks and harbour facilities.

Formulating market and trade policies

One way for countries to build resilience to external food market shocks is to make their agriculture and food sectors more competitive. Such efforts depend on four factors:

- Markets must function properly with low barriers to entry and reduced risks.
- Market prices and margins should permit smallholders to remain active in trade.
- Trade policy instruments (such as tariffs and other trade-facilitating measures) must be conducive to smallholder farmers participating in the market and become part of modern supply chains.
- Supportive policies should guarantee that market engagement also improves welfare.

Generally, poor countries have fewer opportunities and more limited resources to make market competition and trade facilitation policies feasible.

Ensuring sufficient competition in agricultural markets

Competition in food and agricultural markets is crucial to food security, determining the possibilities for smallholder farmers' participation in food value chains and markets, and heavily influencing the formation of prices and the distribution of rents. That is why governments pursue competition and market entry policies – to support the position of farmers and middlemen in domestic food value chains, to safeguard the public interest in food security and to promote a more equitable distribution of wealth (**BOX 5.3**).

Competitiveness in agricultural markets can provide incentives for smallholders to modernize and invest, and it shapes the space for value chain interventions to support poor but efficient producers (CHAPTER 6). Conversely, a lack of competition can lead to monopoly rents that substantially reduce the welfare of consumers, the income of farmers and the effectiveness of government policies (FAO, 2016; Bellmann, Lee and Hepburn, 2019; Mooney, 2018).

BOX 5.3 SUPPORTING FOOD SECURITY IN NIGER

The Maradi district in Niger has a predominantly rural population (86 per cent), most of whom live in poverty (the poverty rate in the district is 87 per cent). Severe chronic malnutrition, experienced by 54 per cent of children under the age of 5 years in the district, is a by-product of several factors leading to food insecurity. Part of the issue can be linked to improperly functioning markets and low accessibility to markets. To ensure market efficiency and healthy trade, investments and policy in rural Niger must create an environment for markets to thrive.

The Project to Support Food Security in the Region of Maradi (PASADEM) prioritized increased access to rural markets and market resilience strategies by reducing the risk posed by participation and providing clear pricing information for market participants. More available markets would benefit producers from higher traffic while simultaneously allowing consumers to achieve greater food security through the increased access to food in markets. The project aimed to support local and national policy to ensure maintenance and sustainability of its market investments.

The construction of three semi-wholesale markets, 11 satellite collection centres and 88.42 kilometres of rural feeder roads all contributed to market access and increased trade. Publicly displayed pricing information created healthy competition among producers, with both producers and consumers benefiting from the resulting reduction in transaction costs.

Source: IFAD project completion reports and impact assessments.

Monopoly rents are an outcome of concentrated market power, where food value chains lack competitiveness. Generally, market configurations and competitiveness vary considerably within and across countries and regions. Despite pervasive expressions of concern about insufficient competition in food and agricultural markets within developing countries, scarce evidence exists for non-competitive pricing in these countries (FAO, 2016; OECD, 2019). Focusing on grain markets in sub-Saharan Africa, Dillon and Dambro (2017) find that food markets in these countries are generally quite competitive.

Food value chains are more likely to suffer from non-competitiveness across countries – at the global level – than within developing countries. Because agriculture is at the base of a food value chain that includes processing and retailing, market power may exist at either or both of these stages. Market power can be difficult to measure because of conceptual and data issues. Still, export firms have many ways to charge non-competitive rents, especially when markets are concentrated globally: three notable examples are cocoa grinding (Gaji and Tsowou, 2015), coffee exports (Grabs, 2017) and banana export (FAO, 2014).

Four transnational companies have an estimated two thirds of the global market share in seeds (**FIGURE 5.5**). Three of them also have the largest stakes in the globally operating chemical input (pesticide) industry – in which the top five companies control 70 per cent of the global market.

FIGURE 5.5 WORLDWIDE MARKET SHARES OF THE LARGEST COMPANIES

Seeds	Agro-chemicals	Fertilizers	Animal pharma-ceuticals	Livestock genetics	Farm machinery	Grain trade	Food and beverage processing	Food retail
Top 4 67%	Top 4 70%	Top 5 18%	Top 3 36%	Top 4 Poultry 97% Top 4 Pigs 67%	Top 5 41%	Top 4 90%	Top 10 of top 100 37.5%	Top 4 in Germany 85% Top 4 United States 50%

Source: IPES Food, 2017; Mooney, 2018.

Because of the importance of competitiveness generally, and because of the extreme concentration and market power in global food value chains, food security policies that target farmers or consumers through trade policies need to reflect the extent of competition throughout the supply chain and the bargaining power of relevant stakeholders. Such policies also need to ensure dialogue with local and globally operating food firms. In other words – over and above the investments in food market infrastructure and knowledge outlined earlier – trade policies require inclusive governance regimes as organization-like entities, simply to balance interests among key parties.

Making domestic agriculture more efficient and competitive

Most developing countries have room for policy manoeuvring within the internationally agreed World Trade Organization (WTO) framework and trade rules, because most current tariffs fall short of bound tariffs – that is, they are below the upper limits on tariffs (Laroche-Dupraz and Postolle, 2013; Matthews, 2014). For many less economically developed countries, import tariffs are usually the only policy tool available, because these countries cannot afford to subsidize their farmers.

As noted, raising tariffs can generate significant costs and may not improve food security, reduce consumer prices or facilitate trade flows. Even so, tariff hikes – if only temporary – may be worth looking into as a strategic choice to protect the most fragile producers during the food system transition. In particular, countries may consider this strategy when they face trade-offs between using limited public resources for agricultural subsidies and using them to invest in rural infrastructure, education and social protection.

When the 1995 WTO Agreement on Agriculture set spending ceilings on agricultural support, it distinguished between price and income support measures. To date, developing countries scarcely use the domestic subsidies

defined by the agreement as "more than minimally" trade-distorting yet still fall below its permitted upper limit (Matthews, 2014). In addition, developing countries, in pursuing their food security goals, are entitled to unrestricted use of domestic funding for:

- "Green box" subsidies – government-funded direct payments to farmers for environmental service delivery that are assumed not to distort trade (WTO Agreement on Agriculture, annex 2).
- Investment subsidies to support innovation and competitiveness that are generally available to agriculture in developing country members, and agricultural input subsidies that are generally available to low-income or resource-poor producers (WTO Agreement on Agriculture, article 2).

Assuming that financial sums spent under agricultural support practices will not "more than minimally" affect other countries' production and trade, developing countries should consider using the investment and input subsidies allowed under WTO rules to the greatest extent possible – though with a format significantly different from that of current subsidies. As subsidies are now formulated, they often reduce overall economic efficiency, lead to overproduction and create perverse health, environmental and equity outcomes. For the most fragile poor countries, if they enact tariffs to protect their agriculture (as contemplated here), the revenues from those tariffs could help fund agricultural subsidies. However, there is a trade-off between using limited public resources for agricultural subsidies and using them to invest in rural infrastructure, education and social protection. It is important to recognize the complex questions around the use and targeting of subsidies and to ask who really benefits.

The COVID-19 pandemic has reignited the global conversation on food self-sufficiency. It is possible to promote greater food self-sufficiency by adding border protections against competitive foreign supply. But raising trade barriers can also entail huge costs – including for the poorest.

Adopting trade and market facilitation policies

To make the best use of export market opportunities, governments can align sanitary and phytosanitary (SPS) measures – and other non-tariff measures affecting trade – with regional standards and global (WTO) standards. As cross-border movement of foods continues to increase, the potential for contaminant spread is high, prompting a global focus on safety and quality. The WTO SPS Agreement sets out the basic rules for food safety and animal and plant health standards. The Technical Barriers to Trade Agreement concerns standards and technical regulation in areas other than health and safety: these areas include quality, the environment and social welfare.

Many countries aspiring to enter global agrifood trade need international assistance with food safety and quality investments. Because trade in agrifood products is increasingly affected by the domestic food safety and quality regulations of destination countries, investing in these areas is a precondition

for benefiting from such trade (OECD, 2019, 2020). Setting up and managing a food safety system is a broad challenge: it encompasses regulations, infrastructure such as laboratories, cold storage facilities, management systems and ICT networks, and requires risk assessment organizations such as inspection services and accreditation bodies. Many developing countries lack the human capacity and resources to set up such a system in accordance with international standards (UNECA, 2018; AGRA, 2020).

Investment in trade facilitation policies is key to reaping the benefits of trade: these mainly concern customs procedures, taxes, permits and administrative trade costs. Poor trade facilitation is a significant driver of food insecurity in Africa, where interregional trade suffers greatly under complex and burdensome import and export procedures. Food availability and food access are significantly reduced by higher documentation requirements and long export and import times (Bonuedi, Kamasa and Evans Osei Opoku, 2020). The most effective trade facilitation reforms to increase food security in Africa are those that reduce delays caused by documentary and border compliance procedures. In particular, infrastructure improvements and digitized trade procedures significantly reduce trade costs (Duval et al., 2018).

Reinforcing standards compliance

Public and private standards, spread through trade and foreign direct investment (FDI), are increasingly important for regulating international trade. To enter and benefit from these markets, low-income countries must invest in raising domestic production and consumption standards and in reinforcing compliance. Including smallholder farmers in food value chains subject to international standards poses multiple challenges: poor farmers lack the resources to invest in standards compliance, and local institutions are not equipped to guarantee surveillance. So innovative strategies are required to involve key stakeholders in designing, implementing and ensuring compliance with food safety and quality standards.

Ensuring that standards benefit small-scale farmers

In recent years, developing countries in Africa and Asia have realized strong growth in food market sectors with rapidly spreading standards. Examples include high-value food products such as fruits, vegetables, seafood, fish, poultry and dairy products. These standards support food exports and contribute to domestic food market upgrading.

Although standards can promote trade, they may not always support inclusive food markets. What determines how the gains from such trade are divided between domestic and foreign populations, and between consumers and producers? The answer depends on particular aspects of a given standard – for example, whether it covers product attributes related strictly to safety, quality and health or also covers other attributes related to production systems,

such as fairness and sustainability. A further determining factor is how these aspects are implemented: publicly, privately or voluntarily (Swinnen, 2016).

Smallholders are more likely to participate in value chains when the farm sector is more homogeneous and when the region contains mostly small-scale farms (Vandermoortele et al., 2012). In contrast, when local production structures are more mixed, sourcing from smallholders occurs only when it is less expensive than sourcing from large farms.

Policies to enhance smallholders' integration into supply chains focus on reducing transaction costs for smaller, less resourceful producers as they enter more modern value chains. One example is managing FDI to integrate smallholders (see below). Another is investing in rural infrastructure (roads, storage facilities, energy, ICT networks) to connect small-scale farmers in remote areas with markets. Exporting traders and firms have often used contract systems – including technology transfers and provisions of inputs – to ensure that farmers can comply with food safety, quality and other standards (**BOX 5.4**).

BOX 5.4 CONTRACT FARMING TO HELP FARMERS COMPLY WITH STANDARDS

Studies of horticultural export chains in Africa show the benefits of providing farmers with specific inputs, such as seeds and fertilizers, as well as with technical advice and extension services. Minten, Randrianarison and Swinnen (2009) find that access to technology and inputs motivated smallholder vegetable farmers in Ethiopia to sign contracts with exporting companies. Bellemare and Novak (2016) show that in other African value chains, such as those for cotton, rice and barley, contract systems with extensive inputs and technology transfers are common for exporters and processors.

Describing the growth of high-value agriculture in Asia, with examples from Bangladesh, India, Indonesia, Pakistan, the Philippines, Thailand and Viet Nam, Gulati et al. (2007) identify important positive effects on farmers' productivity from the rapid rise of their vertical linkages with retailers, processors, and traders and exporters in various forms of contract farming. These forms include input provisions and technology and knowledge transfers.

Dries et al. (2009) and van Berkum (2007) summarize the evidence on dairy contracting systems from various countries, showing that providing essential inputs such as credit and animal feed, together with technical advice (on hygiene and breeding, for example), had a major impact on milk quality. Similar contract systems are used in Uganda's dairy sector (van Campenhout, Minten and Swinnen, 2019). Several studies documenting value chain contracting systems in Eastern Europe and Central Asia in the early 2000s, in sectors such as sugar and dairy, are discussed and analysed in Swinnen (2006).

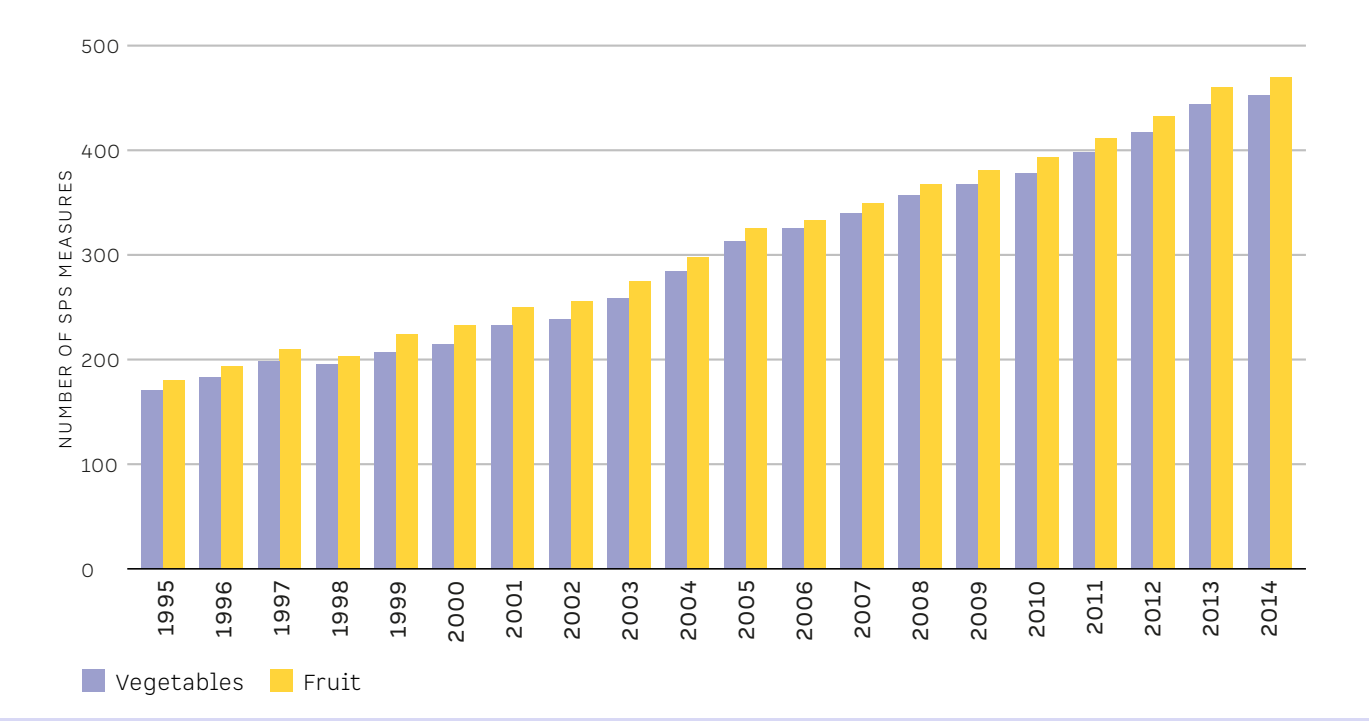
While most pertinent studies focus on export supply chains, some have looked at contract farming systems in chains with mostly domestic operations. Local smallholder suppliers – with limited access to capital and technology – can be integrated into high-value, high-standard sectors through value chain governance based on contracting and on hybrid forms of vertical integration involving technology and input transfers (Ton et al., 2017; Swinnen and Kuijpers, 2020).

Smallholder farmers also need to be empowered to obtain a better bargaining position in the supply chain. Government policies can support the establishment of producer organizations with proper legislation, and with information and knowledge transfers, enabling them to operate such organizations; financial support measures (such as tax exemptions) are sometimes used. Also helpful for integrating smallholders into value chains are policies that invest in institutions for independent quality and food safety control, certification, public extension and market information services (Reardon et al., 2009; Ton et al., 2017; Swinnen and Kuijpers, 2020). The examples presented in **BOX 5.5** highlight the need for more effective domestic institutions in low- and middle-income countries to meet international food safety and quality standards.

BOX 5.5 NON-TARIFF MEASURES IN DEVELOPED COUNTRIES ARE RISING – AND HITTING FOOD EXPORTS FROM AFRICA

Non-tariff measures have a profound impact on global trade structures and on countries' participation in them. In the European Union (EU), the precautionary motive has resulted in a sharp rise in the number of sanitary and phytosanitary (SPS) measures on agricultural products (see figure below). This rise has affected agricultural exports from Africa to the EU.

NUMBER OF SPS MEASURES IMPOSED BY THE EUROPEAN UNION, 1995-2014



Source: Kareem and Rau, 2018.

BOX 5.5 (CONT.)

Two studies explore the effects of SPS measures on African countries' ability to export to the EU market:

- Kareem and Rau (2018) estimate the impact of EU SPS measures on African exports of fruits and vegetables. Their results suggest that the SPS regulations limit new entrants to markets, even though the regulations have only limited effects on established trade flows. These conclusions are in line with findings that developing countries remain constrained in their exports to the EU by their inability to comply with product and process regulations, including social, environmental and food safety (hygiene) standards. The SPS measures thus create barriers to entry, while tariff protections have become very low for imports to the EU originating from developing countries. For example, under the EU's Everything But Arms initiative, the 50 poorest countries can access the EU market without duties and quotas (ITC, 2015; Bureau and Swinnen, 2018; Kornher and von Braun, 2020).
- Using product relatedness measures, Idsardi and Viviers (2018) study the diversification patterns of exports from Cameroon, the Democratic Republic of the Congo, Kenya and South Africa. Their findings indicate that the regulatory framework of the EU is important – though the main constraints on African export and export diversification continue to be supply capacity and overall trade costs.

Overall, these findings indicate the need for more effective domestic institutions so that African exporters can comply with SPS measures – and with other product and process standards adopted by the EU and by other developed countries.

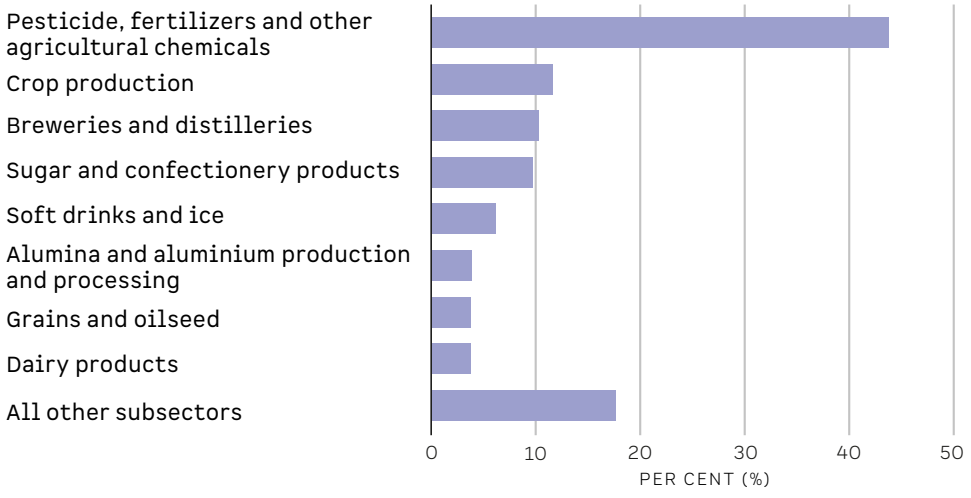
Using FDI to modernize agrifood systems

FDI in the agrifood supply chain brings in new technologies, relationships and knowledge. It also improves access to high-quality inputs and market information. And it plays a key role in introducing private standards for food quality and food safety – and can reduce the costs of compliance (Swinnen and Kuijpers, 2020).

Whereas FDI was initially focused on primary production, more recent investments have been mostly in input services (seeds, fertilizers), food processing, and retail and food services (**FIGURE 5.6**).

Between 2003 and 2017, foreign private investors invested US$48.737 billion in the African food and agriculture sector. FDI inflows peaked after the 2008/2009 agricultural commodity shocks, when international investors rushed to capitalize on high food prices. More typically, critical factors for attracting agrifood FDI include population size, land availability, infrastructure and institutional capacity. Some initiatives – such as Grow Africa and the New Alliance for Food Security and Nutrition – aim to create a conducive environment for agrifood FDI. Local employment and income effects seem to be biased towards better-off households (Wall, Nyamai and Asubonteng, 2018; Husmann and Kubik, 2019).

FIGURE 5.6 SHARE OF GREENFIELD FDI IN THE AFRICAN AGRIFOOD SECTORS



Source: Husmann and Kubik, 2019, based on FDI data from www.fdimarkets.com.

Low-income countries can use FDI to support inclusive agricultural modernization. One approach is to require agroprocessing firms to increase their purchasing and use of domestically produced commodities – a requirement that can be combined with requests to international firms to develop extension support to local farmer-suppliers. Beyond agroprocessing firms, foreign supermarket chains could also be induced to increase their domestic sourcing, a strategy that entails careful analysis of opportunities for backward linkages, including effects on consumers, along with transparent policies to engage, facilitate and enforce commitments among key sector players (BERF, 2018). A Nigerian government policy that sought to induce foreign beer-brewing companies to use local raw material created a conducive environment that boosted the quality of local barley production (Akinyoada, Ekumankama and Uche, 2016). Several other African countries have put ceilings on milk powder imports to encourage local sourcing.

Incorporating environmental externalities and reinforcing non-market values

Improving the environmental and nutritional impacts of food systems is a key objective of transforming food systems, and managing food trade is central to meeting this objective. Current trade systems – focused on market values and economic efficiency – fail to integrate externalities into market prices. To support environmentally sustainable, nutritionally dense and safe food systems, a global system of trade arrangements can enshrine these non-market values at the heart of global trade. A vital condition of success is for domestic food systems to incorporate contracts and regulations that protect non-market values.

Environmental challenges

Trade may induce greater reliance on more input-intensive production methods, which can harm the environment through soil degradation, nutrient depletion, deforestation, erosion, waterlogging and climate change (Balogh and Jambor, 2020).

There are three broad policy approaches to these trade-related negative environmental externalities (Balogh and Jambor, 2020):

- Consumers, mainly in developed countries, should be incentivized to reduce consumption of livestock products – specifically beef – because demand for these products is an important factor in the trade-environment nexus (Poore and Nemecek, 2018; Duku et al., 2021) (CHAPTER 2).
- Environmental harm can be reduced or mitigated by adopting sustainable technologies (such as precision agriculture and drought-resistant seeds) and improved natural resource management practices (for nutrients, pests, water and soil management) – both of which require investments in knowledge and technologies for the agricultural sector.
- Trade-related policies and regulations can help limit environmental degradation – but they must be harmonized at the international level, not only for environmental reasons but also to reduce compliance costs for exporters. While environmental provisions have increasingly figured in regional trade agreements (OECD, 2020), they generally lack specific environmental targets.

To better integrate sustainable production standards into trade agreements, exporting and importing countries will need to embrace more commonly established sustainability standards, declare these standards binding and include them in bilateral or regional trade agreements. Greater policy space is needed in the WTO multilateral trade context for sustainable and inclusive production methods, especially where the environmental costs of production can be assigned monetary values (see Aspenson [2020] and TEEBAgrifood [2019] for examples of true-cost accounting methods for agricultural production). To meet sustainability requirements in trade agreements, developing countries need help with financial resources and with policy and technical advice.

Food safety and nutrition challenges

Trade rules generally do not include objectives for the provision of healthy diets. To improve nutrition outcomes through trade agreements and instruments, developing countries currently can only frame and adopt trade-compliant policies that align with SPS standards (for which the WTO SPS Agreement refers to the joint FAO/WHO Codex Alimentarius as the relevant standard-setting organization) and that support safe food without discriminating against either domestic or foreign products (**BOX 5.6**).

BOX 5.6 TRADE-COMPLIANT POLICIES TO SUPPORT HEALTHY DIETS

The GLOPAN (2020) report cites a study of 151 countries at different income levels (Dithmer and Abdulai, 2017) that found trade openness beneficial for diet energy supply, diet diversity and diet quality. Two recommendations emerge from the report: countries should align their nutrition focus with WTO rules and make policies non-discriminatory for domestic and foreign products, and they should use domestic policies rather than trade policies to address some diet quality issues.

The report also advocates for more research on how current trade patterns affect diet quality and nutrition and on how diet quality is affected by existing policies in areas other than trade. Such assessments will increase coherence between particular trade policies and goals related to health and nutrition – and suggest how new trade policies can support improvements in diet quality.

Trade can contribute to protecting consumer safety and promoting healthy diets only if the standards and regulations applied to food trade are reflected in domestic food systems. Transparent measures are needed to counter allegations of disguised protection. The need for interventions must be clear, and a comprehensive approach must incorporate both imported and domestically produced products, ensuring that policy measures do not discriminate against either.

The main source of food safety and health risks within developing countries is the informal traditional market, where most poor people buy their fresh and nutritious foods, such as eggs, fish and green leafy vegetables (Grace, 2015). Because formal regulation is difficult to enforce in this context, better results are achieved through broader interventions for clean water and sanitation, combined with awareness-raising among producers and value chain participants.

Living wages and social inclusion

In response to civil society concerns in developed countries – which are, for the most part, importers of food rather than exporters – voluntary certification schemes have emerged that attach a price premium to more sustainable and socially responsible value chain practices. The effects of these schemes on food system outcomes are mixed (**BOX 5.7**). Ostensible benefits for income, inclusion and the environment are not always realized and, when they are, the successes are highly context-specific (Alho et al., 2021; Ruben, 2020; Waarts et al., 2021).

Beyond certification schemes, additional measures are needed to enable smallholders to earn living incomes and to ensure that the schemes have no negative effects. Especially important are policies to enable the adoption of farm management practices for engagement in competitive markets. Among the key bottlenecks to be tackled are improved access to good-quality inputs, credit and extension, and a sound business environment that helps farmers manage production, finance and legal risks.

BOX 5.7 CERTIFICATION SCHEMES IN THE BANANA AND COCOA SECTORS HAVE LIMITED IMPACTS ON SMALLHOLDERS' INCOME

Many certification schemes have been adopted in the banana and cocoa export sectors to endorse more sustainable practices and promote socio-economic change. But in Costa Rica's banana sector and Côte d'Ivoire's cocoa sector, the benefits for workers' livelihoods are unclear and at best modest.

In Costa Rica, the Sustainable Trade Initiative estimated that more than 50 per cent of its banana workers now earn more than a living wage benchmark, while the remaining workers receive wages 10 per cent less than the benchmark. But the extent to which certification schemes were responsible for addressing the living wage gap was unclear – these benefits are commonly correlated with environmental improvements and reduction in pesticide usage.

In Côte d'Ivoire, premiums paid by cocoa certification schemes were found to have negligible impacts on smallholder incomes: the average premium paid was insufficient to lift smallholders to a living income. The cocoa boards of Côte d'Ivoire and Ghana have recently joined forces, coordinating production and market volumes, and are considering building warehouses and grinding facilities that may lead to higher value addition in the producer countries.

Source: Alho et al., 2020.

Incorporating externalities into food prices: trade-offs or synergies?

Food production involves environmental and diet-related health costs that are not factored into prices. If these costs were accounted for, agricultural production costs and food prices would likely be higher. A tension thus exists between incorporating externalities into food prices and keeping food affordable, especially for the poor. Moreover, farmers are likely to incur added production costs for compliance with environmental regulations – and if consumers do not cover these costs, the farmers' profit margins and income will suffer.

How to approach these apparent trade-offs? In recent decades, a range of economic tools have been developed to internalize agricultural sector externalities, from payments for ecosystem services to taxes and subsidies. Voluntary market-driven certification schemes are widely recognized as mechanisms for internalizing the environmental costs of agricultural production – and smallholders' diets and health can be targeted for improvement through schemes to pay them fair prices, enabling them to earn a living income (Waarts et al., 2020). Generally, however, environmental and health costs are scarcely reflected in agricultural prices or incorporated through direct payment measures today, simply because the current market and trade model has emphasized economic efficiency (Clapp, 2016).

Now that environmental sustainability and nutritious food are being embraced more widely as desired food system outcomes, trade rules need to shift as well. Future trade agreements should expand the policy space for ensuring environmental protection and healthy food. Open trade may need to be restricted to reduce stress on water resources, to slow deforestation and to keep greenhouse gas (GHG) emissions within countries' commitments for

reduction (MacDonald et al., 2015). Such a rethinking of the contribution of trade to sustainable and inclusive agriculture requires a reappraisal of the full range of products and services from agriculture – including ecosystem services. Food system transformation policies need to move beyond ensuring tradable products to providing essential ecological services, supporting culture and improving livelihoods.

The risk remains that greater attention to the ecological costs of production could lead to higher food prices – that upward pressure on farmers' production costs will not be contained or covered by more sustainable technology or practices. Such price increases could seriously harm poorer smallholders. For the most vulnerable population groups, the most effective instruments for increasing access to affordable food are social safety net policies and targeted food programmes (conditional cash transfers, nutritional programmes for women and youth, school lunch programmes, food-for-work programmes [Diaz-Bonilla, 2017]). But because internalizing ecological costs will raise food prices for everyone, the best way to enhance food security is through rising incomes and better livelihood opportunities (especially off-farm employment).

Policy priorities for trade and markets

To overcome the potential trade-offs between trade openness and desired food system outcomes, policies should focus on four priorities:

Enhance resilience to external shocks through the diversification of production and of markets. Various strategies can reduce the negative impact of food trade on macroeconomic stability and increase the potential contributions of food trade to greater resilience against external (weather or price) shocks (**TABLE 5.1**). Two strategies for increasing resilience to external trade shocks are:

- Diversify food production and the composition of trade – a strategy that is more available to countries with greater agricultural potential.
- Integrate regional markets to develop comparative advantages in food production – a useful strategy when domestic resources are constrained.

5. **Enhance competitiveness and improve market access for local farmers and SMEs.** The options for public intervention to align food systems with regional and international trade opportunities differ widely for small and large countries – and vary with the degree of food system development and integration. The competitiveness policy toolbox includes:
   - Using WTO rules to make domestic agriculture more efficient and competitive.
   - Managing exchange rates.
   - Facilitating trade and market engagement.

TABLE 5.1 TRADE STRATEGIES FOR THREE COUNTRY TYPES

	COMMODITY-EXPORTING AND FOOD-IMPORTING	FOOD-IMPORTING BUT NOT COMMODITY-EXPORTING	COMMODITY-EXPORTING BUT NOT FOOD-IMPORTING
Good potential for expanding domestic agrifood production	Diversify and expand domestic food production and focus on value added	Diversify and expand domestic food supply	Diversify the agrifood economy
Limited potential for expanding domestic agrifood production	Diversify the economy and suppliers of food	Diversify the supplier network	Diversify into non-agricultural sectors

Source: Authors.

Small countries – and countries with less transparent governance – have fewer options and can thus easily face local monopolies due to higher entry costs. Larger and wealthier countries have more opportunities to invest in innovation and production at scale, improving long-term trade opportunities.

6. **Develop grades and standards, which are critical to support inclusive food systems.** Domestic production and international trade are increasingly regulated by grades and standards – either voluntary or compulsory – that aim to safeguard food quality and safety while reducing transaction costs and risks. Low-income countries must comply with these standards to reap the benefits of trade. If they do not, grades and standards can easily impede trade and reduce access to foreign markets. Substantial investments in infrastructure, vocational training and support services are likely to be necessary before compliance can be enforced.
7. **Incorporate social and environmental externalities and reinforce non-market values in trade policies.** The environmental impact of food trade is considerable, and agricultural commodities are responsible for a substantial part of GHG emissions. Greater integration of sustainable production criteria into trade practices will require both exporting and importing countries to embrace more commonly established sustainability standards, to declare the standards binding and to include them in bilateral or regional trade agreements. Climate finance facilities can then be used to balance regional differences in emission impacts and biodiversity – an increasingly favoured potential adaptation mechanism (Janssens et al., 2020). Social standards, such as living wage and fair pricing standards, may become more enforceable with novel technologies.

Simulation 5 in annex 1 illustrates how increasing import tariffs to promote food self-sufficiency, against a business-as-usual scenario, reduces nutrition security among the poorest people in low- and middle-income countries, at the expense of sustainability.

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CHAPTER 6

Tapping the potential of midstream small and medium-sized enterprises

Many developing countries, with their rapidly growing urban populations, are experiencing a food midstream transition. And their food midstreams – the main purveyors of food to consumers in developing regions – are becoming longer and more complex. They too are growing rapidly (Reardon, Liverpool-Tasie and Minten, 2020; Vos and Cattaneo, 2020). The midstream includes all intermediary entities and activities before and after the farm gate that handle supplying inputs and trading, storing, processing and distributing food to the consumer. The midstream is sizeable and it is essential for achieving desirable food system outcomes: health, livelihoods and sustainability.

This chapter focuses on small and medium-sized enterprises (SMEs) in domestic food midstreams. Their growth offers developing countries potential opportunities for a healthy, inclusive and sustainable food system transformation. It also affords smallholder farmers new ways to access both markets and non-farm employment opportunities, while supplying healthier foods to meet consumer demand.

The chapter focuses on how the expansion and transformation of midstream activities can contribute to livelihoods (especially rural and peri-urban livelihoods), how SME growth can enhance food quality, safety and diversity, and how market linkages through midstream SMEs can support sustainable agricultural production. The chapter develops five key messages:

1. **Midstream SMEs link small-scale farmers to markets.** Whether in input services, food processing, logistics, retailing or wholesale, midstream SMEs have the potential to generate value added while ensuring adequate margins for smallholders. They can strengthen market functions – such as packaging, marketing, safety and standards – and they can blunt the collusion that creates market power in the food chain and reduces farmers' profits. Ensuring that linkages with input and output markets become more direct, and reducing market transaction costs, are key food system governance priorities for improving small-scale farmers' livelihoods.

2. **They can deliver affordable food to urban and rural consumers, with implications for diets, nutrition and health.** They can improve the quality and diversity of food through effective value chains for perishable nutrient-dense products, and through food processing and packaging practices that promote higher nutritional quality and longer shelf life. But since they are largely informal, food safety can be a challenge – and their activities could promote excessive consumption of ultra-processed food (UPF) and food services, harming health.

3. **They generate employment, female entrepreneurship and livelihood opportunities.** The midstream enables rural people to look beyond primary agricultural production for income, providing marginal rural households with critical alternative entry points into the labour market, as well as access to good self-employment opportunities. Midstream employment can be highly volatile, though – surrounded by uncertainties and vulnerable to fierce competition, with potential for low remuneration and limited social security. In many agrifood midstream sectors, incomes are less than a living wage and working conditions are far from decent, while insecurity and uncertainty are high.

4. **They can support circular and sustainable food systems if barriers are addressed.** A special challenge for midstream SMEs is their often limited capacity to ensure environmental and social sustainability. The midstream supplies a large share of farmers' agrochemical inputs, generates a large share of food waste and discarded packaging, and uses considerable energy and water resources. Efforts to encourage midstream sustainability could include the education of midstream constituencies about sustainable production practices and circular food system principles (CHAPTER 4), combined with delivery contracts that support long-term relationships and co-investment with upstream or downstream partners.

5. **Midstream SMEs need governance structures to support infrastructure development, public and private investment and technical innovations – especially to meet standards for safety, quality, sustainability and social responsibility.** Shaping midstream SME development to deliver desired food system outcomes involves several key governance challenges. Investments will be needed to improve midstream SME market access through infrastructure, to build their human capital and to expand their financial access. Given the informality of many SMEs and the resulting challenges for compliance with standards, midstream governance will require not only public policies but social networks to establish effective norms for food safety and quality, in a governance structure that imposes some constraints on stakeholders.

In view of the diversity of midstream activities and the wide implications of these activities, readers should note that this chapter's discussion of midstream SMEs and desirable food system transformation is not comprehensive: other chapters also address pieces of the midstream puzzle. For example, the contribution of the midstream to improved nutrition and health will depend heavily on policies to develop rural-urban market linkages and on incentives for improving food product quality (CHAPTERS 1 AND 7). And the contribution of the midstream to environmental sustainability depends in part on strategies to reduce food loss and waste all along the value chain (CHAPTER 4). Finally, along with the opportunities presented by midstream SME growth come substantial challenges and risks. All else being equal, agrifood midstream SMEs can reduce food prices by transmitting farm productivity gains to consumers, especially with investments in SME capacity and efficiency – but this transmission may not occur if local markets are inefficiently integrated or insufficiently competitive (CHAPTER 5). Another challenge arises from midstream SMEs' largely informal status: while constraining SME access to formal finance, informality also increases the risk that they will not meet food safety standards, thus preventing them from participating in high-value export chains where standards regulate markets (CHAPTER 5).

Serious concerns were raised worldwide about potential severe disruptions that the COVID-19 pandemic could have generated for the food system and for people's livelihoods, as well as for local and global economies, and about the role of local and global food supply agents and SMEs. But food systems "resisted" the shock and SMEs played a key role locally, especially in the informal market (Reardon and Swinnen, 2020; Béné et al., 2021).

Improving small-scale farmers' access to markets

The great majority of smallholder farmers' midstream transactions today are with SMEs (Reardon, Liverpool-Tasie and Minten, 2020). In the regional consultations that we cite throughout this report, respondents overwhelmingly affirmed that midstream SMEs were very or extremely relevant to inclusive food system transformation (**BOX 6.1**).

BOX 6.1 MIDSTREAM SMEs HAVE KEY ROLES IN FOOD SYSTEM TRANSFORMATION

In the regional consultations, the large majority of respondents felt that SMEs in the "hidden middle" played a vital role in inclusive food system transformation, calling them either very relevant (42 per cent) or extremely relevant (43 per cent) to their own context. Similarly, the statement that public investment and policy incentives are needed to engage the private sector in food system transformation processes was rated by a similar share of respondents (82 per cent) as either very relevant (45 per cent) or extremely relevant (31 per cent) to their context. Each statement was found to be not relevant to their context by just 4 per cent of respondents.

Source: Regional consultations.

Whether in South-East Asia, sub-Saharan Africa or Latin America and the Caribbean, domestic value chains and especially midstream SMEs supply most of the food consumed by both rural and urban residents – even though imports of some staple foods and processed foods are growing rapidly (CHAPTER 5 and Reardon et al., 2021). In addition, SMEs provide smallholder farmers with complementary services normally available through contracts with larger firms (**BOX 6.2**).

For inclusive food system transformations, transactions between smallholder farmers and midstream SMEs should enable the smallholders to benefit from access to yield-increasing inputs and from sales at more distant markets while also reducing the smallholders' transaction costs and risks. In most low- and middle-income countries today, local shops and delivery networks operated by private agents supply farmers with inputs and provide them with technical assistance. In Africa, wholesale and retail input firms – such as seed and fertilizer dealers – serve farmers who may not be able to travel to cities (Liverpool-Tasie et al., 2019).

SMEs in the output value chain also supply farmers with inputs, as with Uganda's medium-sized dairy processors (van Campenhout, Minten and Swinnen, 2019). Farmers on occasion may receive cash or in-kind advances from traders, conditioned on a commitment to sales after the harvest. SMEs also provide agricultural services, such as combine harvesting for rice in China (Zhang, Yang and Reardon, 2017); land preparation, spraying, pruning, harvesting and marketing for mangos in Indonesia (Qanti, Reardon and Iswariyadi, 2017); and seed propagation, well and pond digging, spraying, land preparation, harvesting and loading trucks for vegetable farming in Ethiopia (Minten, Mohammed and Tamru, 2020). These services help farmers who may lack the funds to invest in machinery and the skills to use machines and other inputs. Or they may simply cut the time needed for farming, enabling more rewarding off-farm employment.

BOX 6.2 SMEs LINK FARMERS TO MARKETS AND PROVIDE COMPLEMENTARY SERVICES

Based on a scoping review of 202 studies, Liverpool-Tasie et al. (2020) find that SMEs in non-contract relationships commonly undertake complementary resource provision: this includes input provision, credit, logistics and, more generally, information, extension and training. Providing these services improves farmers' welfare through technology adoption and greater productivity.

Complementary services appear to be instrumental in fostering positive outcomes from farmers' interactions with input and output market channels. Training and capacity-building support small-scale producers in upgrading their production to satisfy the requirements of modern market channels. Market information increases the speed of farm product sales while allowing farmers to bargain more effectively and obtain better prices. Providing timely access to credit supports the adoption of technology.

Caution is needed here about the effects of midstream actors' market power. When SMEs in the input and agricultural service value chains are able to condition the availability and cost of inputs to farmers, this power may constrain the farmers' ability to make productive investments (Reardon et al., 2021).

In sum, input and agricultural service midstream SMEs can – and in principle should – increase farmers' profit margins by reducing wholesale and retail margins and reducing transport and transaction costs. Note that midstream SMEs often condition the availability and cost to farmers of inputs for new investments that will increase their productivity (see **BOX 6.2**).

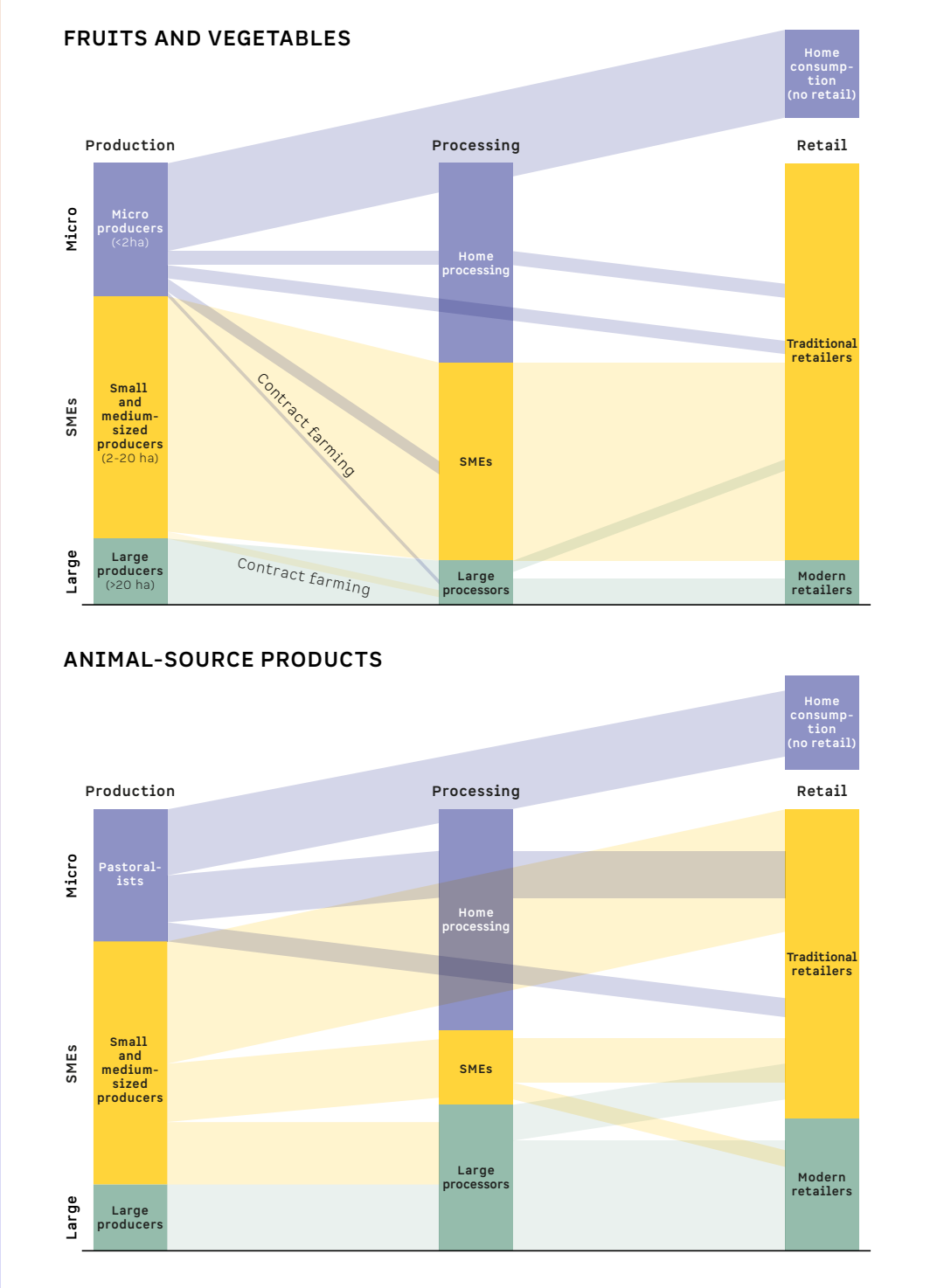
However, in many countries – notably those where markets function poorly and transaction costs are very high – a large part of farmers' potential profit margin is captured by intermediaries. While these intermediaries provide seed and other inputs on credit (to be repaid after the harvest), the returns to farmers are very low. Still, the farmers must depend on such intermediaries because of a lack of alternatives. Ensuring that midstream SMEs provide key mediating functions at reasonable prices and allow farmers to realize fair profit margins hinges on farmers' bargaining power – and on the degree of input and output market competition (Lipper, Anderson and Dalton, 2010; Cavatassi et al., 2011).

Food supplies are delivered to consumers largely by midstream SMEs, including traders and processing, wholesale and logistics enterprises (**BOX 6.3**). Because such SMEs often operate informally – without contracts – and are often not registered as companies, their activities are not fully reflected in official statistics. Still, many indications point to fast growth in the agrifood midstream in recent decades, given the pace of growth in rural-urban midstreams. For sub-Saharan Africa, Haggblade (2011) showed that the traded volume in rural-urban midstreams had grown by 800 per cent during the previous 25 years. For South-East Asia, Reardon and Timmer (2014) calculated that rate at 1,000 per cent. According to a recent estimate, 43 million microenterprises and more than 1 million SMEs exist in sub-Saharan Africa (Bruhn et al., 2017).

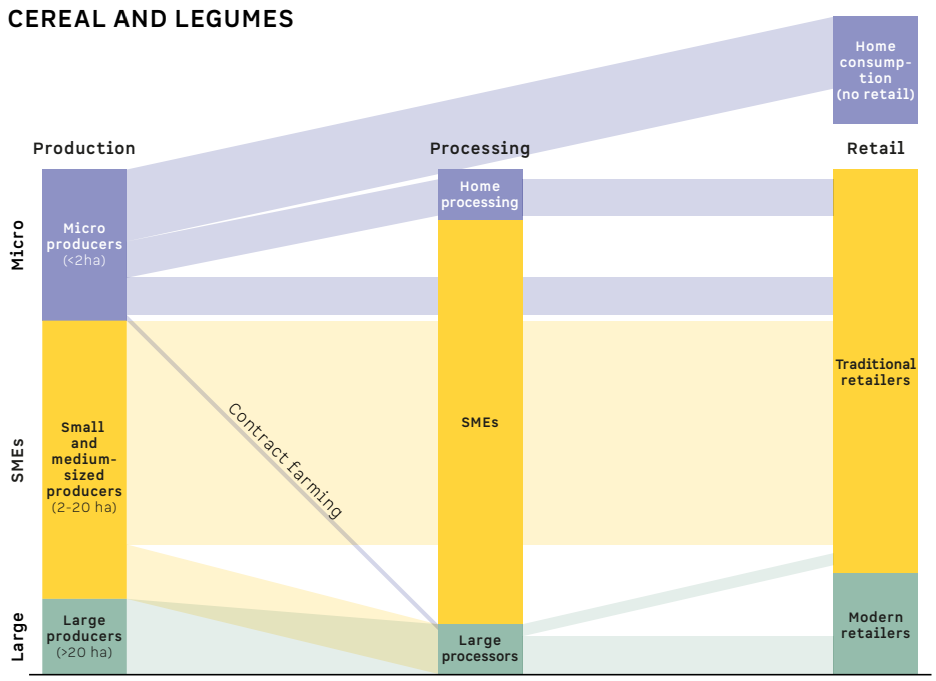
BOX 6.3 THE FLOW OF PRODUCTS ALONG THE FOOD VALUE CHAIN

In Africa, SMEs play a critical role in producing, processing and marketing fresh fruits and vegetables, as well as meat, dairy, cereals and legumes, particularly for low-income consumers.

The relative importance of various segments of the value chain is illustrated here in the flow of food products from producers and processors to retailers.



BOX 6.3 (CONT.)



Source: Demmler, 2020.

Delivering nutritious and safe food, with implications for diets and health

Midstream SMEs support food security by increasing food access – including access to more diverse foods, which can improve nutrition and diets. They can also support food quality through upgrades in storage and processing. They often face challenges in supporting food safety and quality standards, so policies and programmes need to raise awareness and promote compliance.

Midstream SME development can result in cheaper and more diversified food

Agrifood midstream SMEs make value chains more effective, link consumer demand to producers and process primary products to improve shelf life or to add other qualities appreciated by consumers (CHAPTER 4). One major contribution that midstream SMEs can make is to reduce the seasonality of access to various foods – offering consumers more diverse, and potentially nutritious, diets over a longer period. Cold-storage investments can greatly reduce the seasonality of the potato market in Delhi, India (Das Gupta et al., 2010; Minten et al., 2014), and SMEs that dry and smoke fish have reduced

seasonality in the fresh fish market in Nigeria (Liverpool-Tasie et al., 2021). Reductions in the seasonality of access are directly linked to reduced food prices – along with increased prices paid to farmers.

Midstream SMEs are often core suppliers of nutritious foods. For example, about 75 per cent of all mangoes produced in Indonesia are consumed in rural areas and supplied through a chain almost entirely run by SME traders and retailers (Qanti, Reardon and Iswariyadi, 2017). In Uganda, SMEs in processing, logistics and wholesale are the mainstay of milk supply (van Campenhout, Minten and Swinnen, 2021). In Nigeria, SMEs account for a large majority of the fish and chicken supplied to urban areas, which is where these foods are mostly consumed (Liverpool-Tasie et al., 2017, 2021). In the vegetable midstream for Addis Ababa, Ethiopia, SMEs are the mainstays of transport, packing and wholesale (Minten, Mohammed and Tamru, 2020).

Nutritious traditional meals are sometimes both produced and sold by SMEs, especially in urban areas. One example is *teff enjera* (pancakes) in Ethiopia (Minten et al., 2016). Others include millet and dairy dishes in Burkina Faso (Reardon, Thiombiano and Delgado, 1989) and Senegal (Chase-Walsh, 2018). In Tanzania, SMEs mill nutritious flour from pulses and coarse grains and sell it as weaning food (Snyder et al., 2015). Fermented foods are usually produced by small-scale enterprises under female entrepreneurship (CHAPTER 7).

Nevertheless, among SMEs that produce and market processed foods, some make UPF that carry health risks to consumers. Examples include a range of snack-food SMEs in Africa (Reardon, Liverpool-Tasie and Minten, 2020). In Kenya, SMEs tend to dominate sales of UPF – mainly because food retail is still dominated by small traditional shops (Demmler, Ecker and Qaim, 2018).

Midstream SMEs can contribute to food quality

Midstream SMEs contribute to product differentiation and economies of scope, which constitute a key factor in quality upgrading. Trends towards custom wholesaling for supermarkets, fast-food chains and processors put greater demands on timing, volume and quality transactions. Meeting these demands requires investment in dry-storage and cold-chain facilities. Wholesalers who make these investments then become specialized dedicated wholesalers (Reardon and Berdegue, 2002), or quasi-agents for the modern food industry. They may also manage contract farming schemes to enhance input use and support farm-level quality management (CHAPTER 5).

The size of processing enterprises is correlated with the quality, as well as the quantity, of machines, in the sense that larger firms are more able to invest in processes that diversify and differentiate products. In Bangladesh and Viet Nam, the larger a rice mill, the more likely it is to have colour-sorting and rice-polishing equipment lines that increase the rice grade (Reardon et al., 2014). This equipment reflects a significant threshold investment – not one that is feasible for small mills. The same holds for milk collection centres and dairy plants.

Food quality management has become a key ingredient in creating consumer loyalty and guaranteeing compliance with lead times in agricultural food chains. It is also a mechanism for increasing productivity and reducing loss and waste. Next generation technologies for food e-commerce and home delivery of fresh food are even more demanding of consistent food quality. Public investment in infrastructure and in spatial planning provides opportunities to ensure that consumers have access to affordable nutritious foods, support informal food vendors' livelihoods and reduce food loss.

Fortifying wheat flour is fairly centralized, but Ethiopia has more than 300 mostly small-scale wheat mills. Fortifying maize flour involves thousands of small-scale millers. Fortifying salt can be fully centralized (as in Nigeria), almost fully centralized (as in Kenya) or done by a combination of SMEs and large businesses (as in Ethiopia, Mozambique and Tanzania). Similar variation in the involvement of SMEs and large enterprises is seen for wheat flour and oil fortification (Demmler, 2020).

Food safety management by midstream SMEs

Food safety and quality are generally assured by standards, but in low- and middle-income countries well-functioning national food safety systems remain a major challenge (see Roesel and Grace, 2014; Grace, 2015; and Lamuka, 2015, for examples in sub-Saharan Africa, and Minten, Singh and Sutradhar, 2013, for India). Agrifood SMEs typically cannot afford the cost of compliance with formal standards because of their small size, their generally informal status and the perception of banks that lending to SMEs is risky (Randolph, 2021; Reardon et al., 2021). Moreover, SMEs may have difficulties enforcing food safety and quality standards or imposing practices on farmers and intermediaries. These challenges imply a need for programmes that:

- **Create awareness and inform midstream SMEs about food safety and quality regulations.** Programmes are needed to raise awareness of hazard analysis and critical control points to upstream, midstream and downstream actors – explaining the rules and promoting the benefits of compliance. In sub-Saharan Africa, past food safety measures have had little impact, or even an adverse impact: the reason is that SMEs, including vendors, small eateries, traders and processors, have little awareness of the rules or do not know how to follow them correctly (Randolph, 2021).
- **Create incentives to encourage investment in standards compliance.** Ensuring food safety and quality requires SMEs to make investments and to innovate – and they will do so if the market rewards them for it. In Nigeria, SME processors that made a porridge called *ogi* for weaning infants adopted lactic acid fermentation to reduce aflatoxin and fumonisin in maize. Also in Nigeria, a medium-scale chain of food service outlets selling *fura da yoghurt* (a traditional millet and dairy dish) has competed and expanded by promoting its product as more hygienic than the traditional version made with fermented milk (Reardon et al., 2021).

Midstream SMEs will become more likely to invest in food safety when labelling regulations are added to food safety regulations – and when both are combined with public assistance to pay for the investments needed and build human capacity (for example, digital apps to train processors in best practices). Policies need to allow for the fact that, in most developing countries, consumer willingness to pay for safe food is low. While technical assistance programmes can help an industry upgrade its food safety, such programmes are unlikely to succeed by themselves: they should be accompanied by subsidies, tax incentives and consumer education.

Providing attractive alternative livelihood opportunities

The development of agrifood SMEs generates many rural and urban employment opportunities. As part of an inclusive food system transformation, desirable livelihood outcomes can be stimulated by improving labour conditions in midstream SMEs.

Agrifood SMEs are a major source of rural and urban employment

Domestic food value chains are a major source of both rural and urban employment. According to livelihood surveys from 13 countries in Africa, Asia and Latin America (Dolislager et al., 2020), agrifood midstream employment (post-farm-gate) accounts for about 21 per cent of rural employment in developing regions – measured in full-time equivalents (FTEs) – while own farming accounts for 29 per cent. For comparison, in urban areas of the same 13 countries, agrifood midstream employment accounts for 25 per cent of all employment (**TABLE 6.1**). A large share of this midstream employment is in SMEs: in Africa and South Asia, they make up at least 80 per cent of all agrifood midstream activity (Reardon et al., 2021, based on Dolislager et al., 2020).

Data reveal some clear differences among regions (**TABLE 6.1**). In sub-Saharan Africa, agrifood midstream employment makes up a significantly higher share of all urban employment (31 per cent of urban FTEs) than in the other two regions, which have more developed economies (27 per cent of urban FTEs in Asia, 18 per cent in Latin America). Agrifood midstream employment is also a larger share of rural employment in sub-Saharan Africa than in the other two regions.

TABLE 6.1 RURAL AND URBAN EMPLOYMENT, ON AND OFF THE FARM

REGION	RURAL EMPLOYMENT				URBAN EMPLOYMENT IN FOOD SYSTEM ACTIVITIES
	OWN FARMING	FARM WAGE EMPLOYMENT	NON-FARM SME EMPLOYMENT INSIDE THE FOOD SYSTEM (SELF-EMPLOYMENT + WAGE EMPLOYMENT IN AGRIFOOD ACTIVITIES)	NON-FARM EMPLOYMENT OUTSIDE THE FOOD SYSTEM	
Sub-Saharan Africa	39	3	24	34	31
Asia	27	13	18	43	27
Latin America and the Caribbean	16	12	21	50	18
Overall	**29**	**9**	**21**	**41**	**25**

Source: Reardon et al., 2021 based on Dolislager et al., 2020.

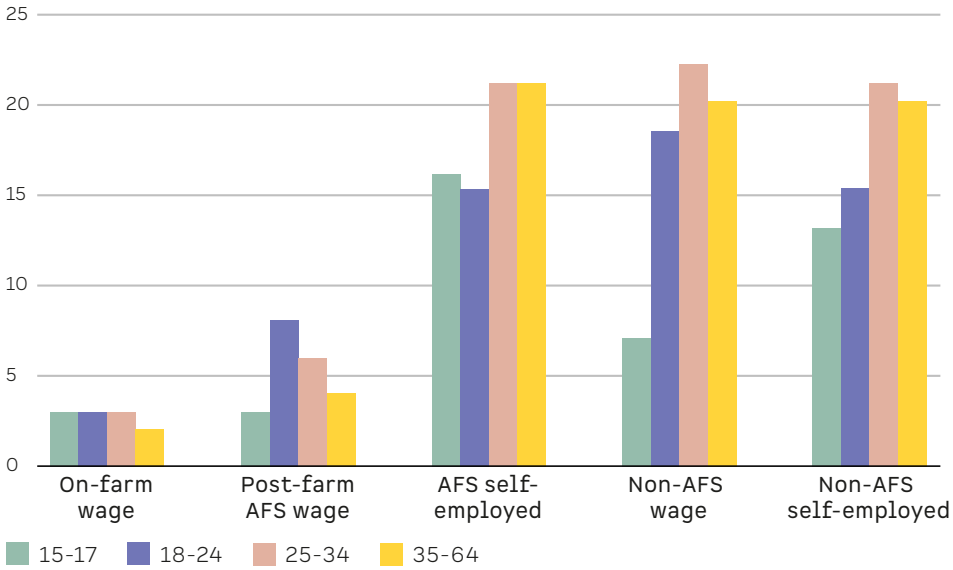
Note: Data are from Living Standards Measurement Study surveys of 178,794 households with 460,654 individuals in sub-Saharan Africa (Ethiopia, Malawi, Niger, Nigeria, Tanzania, Uganda), Asia (Bangladesh, Cambodia, Indonesia, Nepal) and Latin America (Mexico, Nicaragua, Peru), in all age cohorts (youth aged 15-24 and adults aged 25-64) and both genders. Employment is reported in full-time equivalents (FTEs). Non-farm employment inside the food system includes post-farm-gate food processing, wholesale food, food-related logistics, food retail and food service.

Rural women depend more than rural men on agrifood SME employment: on average, across all three regions and in all 13 countries studied (Dolislager et al., 2020), the share of such employment in total FTEs is 30 per cent for women, compared with 19 per cent for men. These findings coincide with SME studies. For example, in Ghana women dominate the agroprocessing segment (Ampadu-Ameyaw and Omari, 2015, cited in Reardon, Liverpool-Tasie and Minten, 2021).

Dolislager et al. (2020) also show that dependence on food system employment is similar between youth and adults in the segment of wage employment (**FIGURE 6.1**). Wage work in the post-farm segment of the agrifood system is the only category where youth between the ages of 18 and 24 spend more time than any other age group. Young adults between the ages of 25 and 34 also dedicate more time to wage work in the agrifood system than do adults above that age. Self-employment is most important for those above 25 years of age, given the time needed to accumulate savings, experience and skills to start up one's own business.

One reason for the growing importance of urban food system employment is that urban settlements now dominate the market for food consumption, accounting for about 60 per cent of all food consumption in Africa and South Asia, 70 per cent in South-East Asia and 80-90 per cent in Latin America. Two studies of Ethiopia and Nigeria, while estimating the numbers of people employed in various midstream and downstream food system segments, highlight the creation of employment through interactions among parts of the midstream (**BOX 6.4**).

FIGURE 6.1 FULL-TIME EQUIVALENT SHARES IN EMPLOYMENT CATEGORY BY AGE GROUPS



Note: AFS = agrifood system.
Source: Dolislager et al., 2020.

BOX 6.4 OFF-FARM AGRIFOOD EMPLOYMENT IN ETHIOPIA AND NIGERIA

Based on primary surveys in three cities (Addis Ababa, Dire Dawa and Nekemte) and statistical analyses of food processing and household consumption and expenditure data, Minten et al. (2016) conclude that commercial *enjera* (teff pancake) markets in urban Ethiopia employ 100,000 people – mostly women – and are growing rapidly. Along with food processing and preparation, these jobs often extend to retail sales. The study also showed that 1 million workers are employed in food processing by larger *enjera* processing firms, which are more capital-intensive and sell the product at scale (both to the food service sector and for export).

Sauer, Reardon and Liverpool-Tasie (2020) estimate employment effects in selected segments of Nigeria's maize-food-poultry complex – chicken farms, maize farms, maize traders, feed mills and chicken retailers – taking two consumption centres as the first node (Greater Ibadan in south-west Nigeria, Kaduna City in northern Nigeria). This part of the segment employs roughly 900,000 people, 34 per cent of them women. Including all labour employed by the maize farms and urban traders, the total increases to about 5.7 million people. These figures underestimate the off-farm total employment impact of the complex. Rural maize traders, chicken and egg traders, and third-party logistics firms serving traders (an important missing piece – for example, maize traders in Nigeria move 75 per cent of their volume through these firms) were important key agents left out of the survey, together with farmers, traders and other "lateral" midstreams for inputs.

Source: Reardon et al., 2021.

Food system transformation can be stimulated by improving labour conditions

Agrifood midstream development – especially by SMEs, which are more labour-intensive than large enterprises per unit of output – can support inclusive food system transformations by creating decent jobs. This effect can be magnified with investments to relieve two constraints on SME employment generation, one pertaining to labour, the other to financing:

- To match future labour demand in food processing and services, better technical and vocational education and non-cognitive skill development will be needed (AGRA, 2019).
- To afford future expansion, midstream SMEs will need greater access to finance and loans (KIT, 2015; Dalberg, 2018; van Manen, 2018).

Agrifood midstream SMEs in low- and middle-income countries will very likely employ increasing numbers of youth and women in the coming decades, as food systems shift their emphasis from primary production to processing, trade and services. For people currently poor in rural areas – many of them smallholders who increasingly rely on multiple sources of income, while others are landless wage labourers – these new employment opportunities outside primary production will be beneficial. However, if the midstream becomes dominated by larger enterprises that rely on labour-saving technologies, these effects will be lost.

Policies will thus be needed to protect against the risk that midstream SME expansion could create a poverty trap for rural residents, incorporating lessons from the COVID-19 pandemic, which has highlighted the importance of skills and technology. Specifically, employment conditions will need to improve through labour-intensive value-adding operations in the midstream and through employee skill development. Moreover, public regulations on work conditions – such as minimum wage requirements and rules on the freedom to organize – need to accompany job creation. Civil society representation of employee interests is critical to level the playing field with employers and to bring about a food system transformation that is inclusive and resilient.

Midstream SMEs provide critical conditions for circular and sustainable food systems if barriers are addressed

A potential trade-off in midstream SME growth is the limited capacity of many SMEs to ensure environmental sustainability. This trade-off can be addressed only by understanding the reasons why SMEs face challenges in meeting sustainability standards. One reason is a lack of awareness and knowledge about the potential of circular agrifood systems (CHAPTER 4). Another constraint is a lack of means and insights to establish inclusive food governance systems. Finally, the costs of adopting measures that increase

sustainability are a major barrier, particularly where there is no financial benefit associated with better environmental performance.

Midstream SMEs' technological choices can have direct effects on the environment. An example of where such choices can be beneficial is the rapid and profound shift over just a decade that Ethiopian grain-trucking SMEs made in the size of their trucks, with a concomitant 50 per cent transport cost decline translated into lower fuel use per ton of grain moved, despite a parallel elimination of fuel subsidies (Minten et al., 2014). In a similar vein, investments in energy-efficient food processing and solar-powered cooling facilities are important to reduce dependence on fossil fuels.

Midstream SMEs can also influence the environment and natural resource management practices on farms. The combination of intensification and sustainable practices in Africa – called "sustainable intensification" (CHAPTER 3) – is correlated with farm links to the midstream (Reardon et al., 1995). That intensification can in turn reduce pressure to use land more extensively and to extend into the commons (Angelsen and Kaimowitz, 2001). Sometimes SMEs get involved, directly affecting farmer sustainability practices: agro-dealer SMEs sometimes bundle training in proper input use with the proviso that chemicals could harm the environment if used incorrectly or excessively (Liverpool-Tasie et al., 2020). By facilitating and encouraging small farmer intensification, midstream SMEs in input value chains and food midstreams can lead small farmers to use more inputs that can cause pollution from farm chemicals, siltation from aquaculture, manure from pig and chicken production, and so on – in short, negative externalities for the environment. A good example of a project that triggered and supported SMEs while protecting the environment is the Community-based Forestry Development Project in Southern States (DECOFOS) in Mexico (**BOX 6.5**).

Important environmental externalities from midstream SMEs are also related to their operational efficiency. A tension appears here between the use of plastic and aluminium packaging, which generate environmentally damaging rubbish, and the need for modern packaging to reduce food loss and waste. Consumers in Africa and Asia have diverse expectations for package size, labelling and ease of use. Simple changes in package size can greatly affect sales volumes and top-line revenue. Better packaging also extends product shelf life and prevents decay.

As the growth of fast-moving consumer foods and beverages in developing countries drives increasing demand for packaging materials, recycling companies have begun operations. The public's awareness of the environmental harm caused by packaging is gradually on the rise. An alternative to plastic and aluminium might be innovative, moisture-resistant coatings made from biodegradable material. Otherwise, quality-controlled logistics can make fresh product chains smarter by aligning product quality with consumers' quality demands. Sensor measurements and data exchange throughout food value chains could overcome the trade-offs between quality and sustainability in packaging. Such technologies create occasions for a new, comprehensive look at logistics and packaging in midstreams.

BOX 6.5 COMMUNITY-BASED FORESTRY DEVELOPMENT IN MEXICO

The DECOFOS project was designed to address and overcome problems linked to deforestation and forest degradation in rural communities of marginalized forest areas in Campeche, Chiapas and Oaxaca. The project was carried out through the restoration and reforestation of degraded areas, together with the provision of technical and financial support for the development of microenterprises and sustainable production initiatives.

The project was designed based on an analysis of the problems affecting Mexico's forestry sector – problems driven mainly by deforestation and lack of resources, investments and technical capacity. The project had two main components. The first aimed to improve the organizational, planning and managerial capacities of local communities/*ejidos* through the delivery of training courses and workshops related to climate change effects and the adoption of good agricultural/environmental practices to adapt and mitigate these effects, and the formulation of local development plans, participatory environmental assessments and business plans. The second supported the start-up of microentrepreneurial projects and small businesses related to sustainable production of timber and non-timber forest products and ecotourism. It also promoted the adoption of agroforestry and good environmental practices for climate change mitigation and adaptation.

DECOFOS increased the total asset wealth of beneficiary households by 15 per cent and productive asset ownership by 41 per cent, which resulted in a 22 per cent increase in total annual income among beneficiaries. Results also suggest positive environmental impacts, particularly in Campeche, where the use of natural resources from common land increased by 37 per cent for beneficiaries. In Chiapas, where the project intervention concentrated on supporting small businesses, total income per year increased by 39 per cent among beneficiary households, which translates into a higher average income from business activities of about US$165 a year over non-beneficiary households.

Source: Cavatassi, 2019.

Investing in infrastructure, financial access, human capital and business organization

Shaping midstream SME development to deliver desired food system outcomes involves several key governance challenges (**BOX 6.6**). Generally, midstream governance in food value chains needs to account for multiple networks of interactions that shape conditions for co-innovation: it requires both technical capacity (hardware) and knowledge and information (software), along with norms and organizations for steering food system transformation (Klerkx and Begeman, 2020). Inclusive, bottom-of-the-pyramid business models in food systems must be based on quality improvement innovations, broad-based marketing and distribution strategies, and training programmes – as well as coalition-building to create new norms and overcome institutional and cultural gaps (Danse et al., 2020).

BOX 6.6 VALUE CHAIN DEVELOPMENT IN NIGERIA

In Nigeria, the Value Chain Development Programme enhances rural incomes and food security by targeting inefficient midstream operations and communication. It works with local government, public and private institutions, and regulators to establish action plans within the midstream for specific commodities. It also enhances multi-stakeholder platforms to allow different actors in the supply chain to share knowledge and conduct business transactions more efficiently. It is a key example of incorporating household methodologies to target disadvantaged groups, using the Gender Action Learning System methodology.

To improve market and business linkages of smallholder farmers, the programme promoted an innovative market-led public-private-producer partnership through commodity alliance forums. The forums bring together key private and public stakeholders on a single platform to facilitate business transactions, knowledge-sharing, conflict resolution and policy dialogue. Through the forum, smallholder farmers benefit from market information on, for example, input and output prices, demand (upstream and downstream), loanable funds and more. A spillover effect is a strong producers-off-takers arrangement where farmers have some leverage in price setting and can influence agricultural policies. By 2019, 70,558 women-headed households were engaged through project services, and 41,617 women were supported by the programme (95 per cent above target).

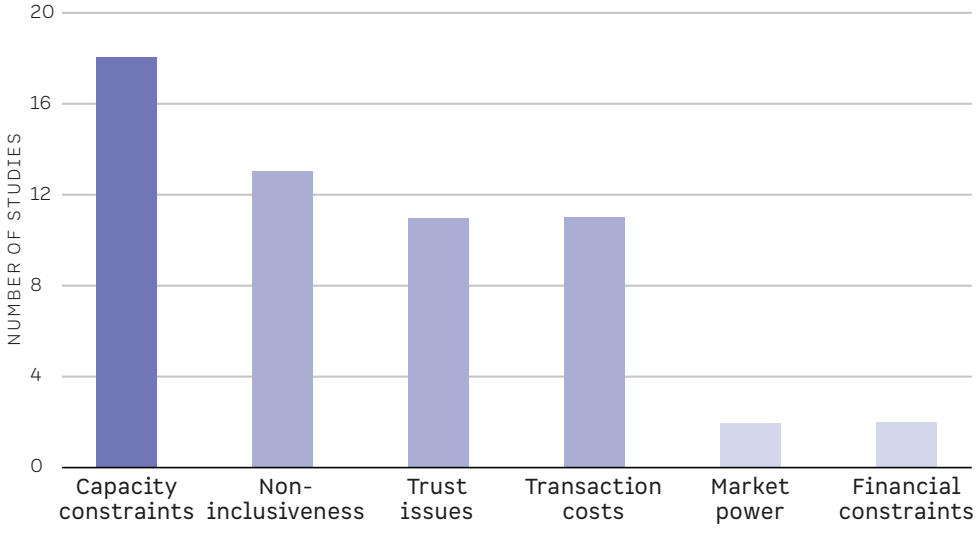
Source: IFAD Value Chain Development Programme, Nigeria, project completion reports and impact assessments.

Distilling the lessons from Liverpool-Tasie et al. (2020), governance initiatives can start by looking at four key constraints on SME participation in healthy, inclusive and sustainable food system transformation:

- **Inadequate infrastructure.** Public investments are needed in physical and communications infrastructure.
- **Weak training and education.** Midstream SMEs can benefit from training in entrepreneurial skills.
- **Limited financial capacity.** Policies are needed to expand SME access to finance.
- **Informality.** This common feature of many midstream SMEs should be seen less as a problem in itself than as a challenge calling for the use of innovative governance approaches.

All of these midstream governance efforts need to focus on midstream transactions, how they are organized and the relationships among parties. Trust between exchange partners needs reinforcement, and reliability must be guaranteed. Also critical is strengthening the bargaining power of smallholder producers, traders and consumers. We know relatively little about this challenge, as it is studied far less than most other constraints facing midstream SMEs (**FIGURE 6.2**). But creating farmer cooperatives and consumer organizations is one promising approach. Another less-studied challenge is financial constraints on midstream SMEs.

FIGURE 6.2 CHALLENGES FACING MIDSTREAM ACTORS IN AGRIFOOD VALUE CHAINS



Source: Liverpool-Tasie et al., 2020.

Infrastructure investments will contribute to inclusive food system transformation

Midstream SMEs working with smallholder farmers in the informal sector have been quite successful in linking farmers to markets – a sign that further support to SMEs in agrifood systems will boost SME development and benefit smallholder farmers economically. Investments in infrastructure and services, aimed at lowering transaction costs, are key to initiating SME activities and increasing rural smallholders' market participation and resource productivity (AGRA, 2019).

In many rural areas of low- and middle -income countries, midstream SMEs are constrained by poor infrastructure, including digital infrastructure (AGRA, 2019; FAO, 2020). Alongside problems with roads and regular access to power, weak digital infrastructure deprives SMEs of an increasingly important element in competitiveness. More generally, poor infrastructure increases transaction costs and reduces the profitability of midstream firms, affecting product retail prices as well as food waste and food quality. Investments in infrastructure – public roads, railways, ports, wholesale markets and electrification, along with mobile phone infrastructure – are thus vital for connecting urban food demand to the midstream entrepreneurs eager to meet that demand.

Transport infrastructure

The importance of good transport infrastructure for reducing transaction costs appears in a recent example from Ethiopia (**BOX 6.7**). Another example is from Nigeria, which expanded highways and rural roads between its northern and southern areas. The expansion spurred development in the trader and

logistics segment, which comprises numerous SMEs, and thus drove growth in the domestic maize midstream: maize producers in the north were connected with retail markets in both the north and the south over a length of about 1,000 kilometres (AGRA, 2019). One immediate effect of the new roads, railways, storage facilities and wholesale markets was to reduce transport time and thereby cut transaction costs – not only for output markets but also for input markets (in fertilizers and feed). Another effect was to improve produce quality through faster handling and better storage.

Although evidence is scarce, wholesale traders' profit margins appear to fall as their numbers increase with the size of operations – an effect of lower handling costs and rising competition. In Ethiopia, as SME traders and truckers invested and multiplied over a decade, three effects followed (Minten et al., 2014, 2016, cited in Reardon, Liverpool-Tasie and Minten, 2020):

- Midstream actors' profit margins – the price gaps between farms and consumers, including mill and retail margins – were reduced as the market became more efficient.
- Spatial integration over the country's wholesale markets increased.
- The number of traders rose, competition rose greatly and average trader size declined somewhat.

Digital technologies

The dynamic development of the midstream is also supported by investments in mobile telephone infrastructure, which boost the use of mobile devices. Digital technologies, including mobile phones, have enormous potential to improve connectivity between suppliers and market agents, and between market agents and consumers (Torero, 2019; Ceccarelli et al., 2021). Digital technologies can make populations of poor people and markets more resilient, as access to technologies can increase the amount and quality of information. For smallholder farmers and the rural poor, better information can mean higher agricultural yields, better trade deals and higher profitability, as well as better job opportunities. It can also promote learning – which will further enhance technology adoption among farmers (Deichmann, Goyal and Mishra, 2016).

Public investment and legislation can stimulate and guide the construction and use of digital networks so that as many people as possible have access to digital services at the lowest possible price. For example, government policies should entice private investors to invest in networks in sparsely populated areas and should ensure healthy competition among private investors to make service prices affordable. Next, policies should stimulate private-sector investments in network rollout and should encourage the offering of useful content in accessible forms. The types of content that could benefit farmers and agrifood SMEs include data specific to the agriculture sector, weather forecasting, advisory and information services (including market information), financial services and midstream management (Ceccarelli et al., 2021).

BOX 6.7 THE ETHIOPIAN TEFF MIDSTREAM TRANSPORT BOOM

In the 2000s, Ethiopia's teff midstream experienced rapid growth and upgrading, driven by investments by large numbers of SME truckers and wholesalers. None of the investments were publicly subsidized – on the contrary, the fuel subsidy was eliminated during that time, making fuel 60 per cent more expensive. Yet transport costs dropped 50 per cent in that decade, and travel time from farm to market fell by 20 per cent.

The drop in transport costs was attributable to three factors. First, the government invested in surfaced roads, which doubled in length over 15 years. Second, private SME truckers invested hugely in trucks to meet increasing demand. Third, the share of small trucks declined: the share of 7.5-ton trucks went from 15 per cent in 2001 to 33 per cent in 2011.

Thanks to these investments, teff sales on wholesale markets across Ethiopia increased by 70-80 per cent over a single decade – and farmers' grain sales doubled, while their fertilizer use also skyrocketed.

Source: Minten et al., 2014, 2016, cited in AGRA (2019).

The risk is that poorer segments of society, and women generally, will be excluded in the digital age if they do not receive specific support, for example in meeting the cost of use. Digital technology is not gender-neutral: in many situations, men dominate the service industry as well as the user community. But mobile phone services also enable women's access to home delivery of food and can be helpful to overcome customary constraints that limit market access.

The COVID-19 pandemic has shown the potentially positive effects of an acceleration towards digitalization, but it has also shown the differences in accessing digital devices, in internet penetration and in access to technology across countries, genders and groups. The pandemic crisis could be a catalyst to help close the current gaps, particularly in low- and middle-income countries, accelerating digital transformation in sectors such as financial services, retail, education, agriculture and government (Ceccarelli et al., 2021).

Investments in educational and training programmes should promote entrepreneurial capacities

Two types of human capital investment are considered to overcome current constraints: educational programmes and training in emotional and organizational skills for the workplace. Less in demand is general technical training – labour skills and quality, along with labour quantity, are not regarded as areas of major constraint (AGRA, 2019).

Where specific skills are needed, a case can be made for targeted vocational training. Many examples pertain to the digital revolution: SMEs will require training to use ICT-enabled technologies for production, food safety and commercial procedures (AGRA, 2019). But young SME entrepreneurs also need assistance to analyse market potential, identify priority policy and regulatory issues and access specialized training in the face of emerging downstream challenges – such as how to meet local and international food safety standards (Allen et al., 2016).

Generally, for midstream development to continue reinforcing food supply, employment and diversified incomes, SMEs need vocational training and sector-wide business organization – and better financial access. The "hidden middle" of midstream agrifood enterprises requires support to fill the "missing middle" of agrifood support services.

Improved lending facilities for SMEs are key for longer-term midstream development dynamics

While access to finance is a major constraint for all types of SMEs, those involved in agricultural midstreams have especially limited access to credit. To banks, SMEs' informal management and lack of collateral appear risky (Alibhai, Bell and Conner, 2017). Further, banks do not give agriculture high priority because it faces risks that banks struggle to understand and manage, such as price volatility and drought – and also because of the high cost of serving rural customers. As a result, agriculture is highly underfinanced. Recent studies show that the trade finance to agrifood midstream SMEs in developing markets is both promising and challenging (**BOX 6.8**).

The generally high operating costs of reaching rural SMEs and the high risk of lending to informal SMEs in agricultural value chains both point to a need for guarantee and risk-sharing facilities. Such facilities can reduce investment risks to lenders, whether the lenders are local or foreign, private or donor. To absorb risk among newer and less formal borrowers, Dalberg (2018) suggests donor interventions such as new types of credit guarantee schemes. Also suggested is capacity-building for lenders with limited agricultural experience, to improve their underwriting and risk assessment. To unlock the flow of finance to agrifood SMEs, four types of blended finance instruments are further recommended for exploration:

- **Output-based incentives.** A financial incentive facility can encourage lending to segments that lenders find unprofitable to serve in the short term but that demonstrate high-impact potential.
- **Risk mitigation.** A risk-absorbing facility, such as a system of partial credit guarantees, can encourage lenders to explore riskier segments, which is particularly important in the context of climate change adaptation.
- **Direct funding.** Providing concessional funding to lenders can lower their required rate of return.
- **Technical assistance.** In addition to direct financial support to lenders, advisory support on risk management or on the use of improved technology can help by lowering lenders' operating costs.

BOX 6.8 LENDING TO AGRIFOOD SMEs

Based on an analysis of 3,600 individual loans provided by nine members of the Council on Smallholder Agricultural Finance, Dalberg (2018) finds that, while over 50 per cent of the trade finance loans were profitable, an average loan of US$665,000 lost about US$1,800 (not including the cost of funds). Further analysis shows that the economics of the loans varied substantially by certain characteristics, including loan size and midstream. Specifically:

- Larger loans performed better than smaller ones – operating costs are similar across different loan sizes, but interest and fee income are proportional to loan size.
- Loans to existing borrowers were significantly more profitable than loans to new borrowers.
- Loans in more formal coffee and cocoa midstreams performed better than loans in other crop markets.
- Short-term loans (less than 12 months) performed better than long-term loans (12 months or more).

Source: Dalberg, 2018.

Generally, poor access to finance is among the main constraints on the private sector's ability to improve food system outcomes. Agrifood SMEs generally are small businesses, without proper accounting, licensing and official registration as commercial enterprises. For midstream SMEs to gain more access to finance, they must become better organized and more professional, lowering the risk perceived by lenders. That requires capacity-building and technical assistance in setting up and running a business – including ways to meet market requirements and comply with standards. This largely informal sector must become part of the food system transformation strategy.

Informality

In low- and middle-income countries, vast numbers of midstream SMEs operate informally through self-regulated networks without legal status – a fact with both positive and negative implications. On the positive side, informality supports inclusiveness in food systems, as informal arrangements are more accessible to small-scale producers than are formal contracts with larger companies. The informal sector has played a notable role in guaranteeing food security since the onset of the COVID-19 pandemic (Wegerif, 2020). On the negative side, one effect of weak institutions, governance and enforcement is a lack of trust between farmers and buyers (Liverpool-Tasie et al., 2020).

Improvements in food system governance need to fully account for the large category of informal midstream SMEs – including street vendors and hawkers – and be informed by a thorough insight into how these businesses function. In contrast to conventional strategies for formalizing informal SMEs, policy approaches may consider alternative strategies that harmonize the informal economy with the needs of more disadvantaged segments of rural society.

The effects of the COVID-19 pandemic on food systems and their resilience indicate the importance of knowing more and in a more granular manner about the actors that operate in food systems and of which SMEs and the midstream are a big part (Béné et al., 2021). Particularly important is knowing more about the formal and informal systems, processors, retailers, transporters, distributors and so on. Granular and precise data related to this segment of food systems would contribute to expanding and deepening knowledge on food systems and their resilience.

Policy priorities for expanding midstream SMEs

Agrifood midstream SMEs can support desired food system outcomes by improving livelihoods and – if properly supported – by improving inclusion, nutrition and sustainability. While linking smallholder farmers to both input and output markets, the midstream segment also creates employment and income opportunities outside primary production, particularly for women and youth. Midstream SMEs are proliferating rapidly in developing regions, and are very likely to develop further and provide employment to growing numbers of rural residents outside agriculture.

Midstream SMEs are proliferating rapidly in developing regions, and are likely to develop further and provide employment to growing numbers of rural residents.

Policymakers should focus on seven priorities:

1. **Enable midstream SMEs to raise agricultural productivity.** In addition to midstream SMEs' role in supporting smallholders in gaining access to quality inputs and good agricultural practices, downstream investments in processing and packaging facilities, transport logistics and cold-chain management help to guarantee continual production and consistent product quality. SMEs are therefore considered key multipliers for investment in domestic and regional markets.

2. **Facilitate midstream SMEs in contributing to food quality and diet diversity.** Food trade in low- and middle-income countries is largely an informal activity. There are substantial benefits to adopting a facilitative approach towards informal businesses. In particular, light-touch interventions centred around training and behaviour change can yield significant improvements in the quality of products and services (Robinson and Yoshida, 2016). In addition, engaging SMEs in food fortification programmes, public food distribution systems (vouchers) and school feeding programmes contributes to healthier diets. Other public support to midstream SMEs includes financial incentives to comply with food safety standards, and facilities to implement technical

assistance programmes to ensure that midstream SMEs deliver safe and healthy foods.

3. **Improve labour market functioning and the business climate.** Further development of agrifood midstream SMEs can support competitive conditions and contribute to a better functioning labour market. These SMEs are the drivers of economic growth, socio-economic inclusion and long-term sustainability. Technical and vocational training provided to youth, adolescents and women has proved helpful in strengthening entrepreneurial activities and enabling entry into self-employment activities. Further public efforts should seek to reduce business start-up costs and to improve the business climate.

4. **Provide market incentives for SME investments to strengthen more circular and sustainable food systems.** Midstream SMEs generate substantial environmental externalities through agrochemical use and through unresolved trade-offs between packaging materials and food waste. Investments in better equipment, technical innovations and knowledge can help midstream SMEs meet sustainability standards. Joint efforts are needed to raise awareness about sustainable production practices and circular principles in the midstream constituency – and will depend on the creation of market incentives for the fair and true pricing of products and services.

5. **Enhance midstream contributions for food system sustainability.** Long-term delivery contracts that support mutual relationships and co-investment with upstream or downstream partners offer interesting experiments in enhancing midstream contributions to food system sustainability. ICT approaches (that is, the use of mobile phones, internet and/or data processing for market information) for smart chain integration and integrated quality logistics based on multi-stakeholder cooperation can speed up the transition to more resilient and circular food systems.

6. **Base supply chain governance on social norms, public policies and private investment.** Because SMEs face challenges in standards compliance, transforming food systems requires a combination of public policies, private investments and social networks to foster adherence to norms – whether for product quality, food safety, decent labour conditions or sustainable practices. Investments are needed to improve midstream SMEs' market access, to build their human capital and to expand their financial opportunities – all within a highly informal, network-based structure.

7. **The "hidden middle" of midstream agrifood enterprises needs support to fill the "missing middle" in agrifood support services.** Beyond improved access to material services, shared norms – for the establishment of mutual trust, reliable transactions and transparent

relationships – are critical to reduce risks of collusion and exclusion. Food system transformation will succeed only if SMEs can overcome discriminatory norms and practices.

Lessons from the COVID-19 pandemic and the resulting restrictions should support SME innovations that were triggered in response to the shock. So far, not much systematic information is available on these entrepreneurial responses, and more granular data are needed. Anecdotal evidence suggests that these innovations will be crucial to shaping the future of the agrifood system and to strengthening its resilience.

Simulation 6 in annex 1 illustrates how subsidizing labour to increase midstream employment, against a business-as-usual baseline, improves inclusiveness but has mixed impacts on nutrition and sustainability.

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CHAPTER 7

Supporting local food processing but moderating the consumption of ultra-processed food

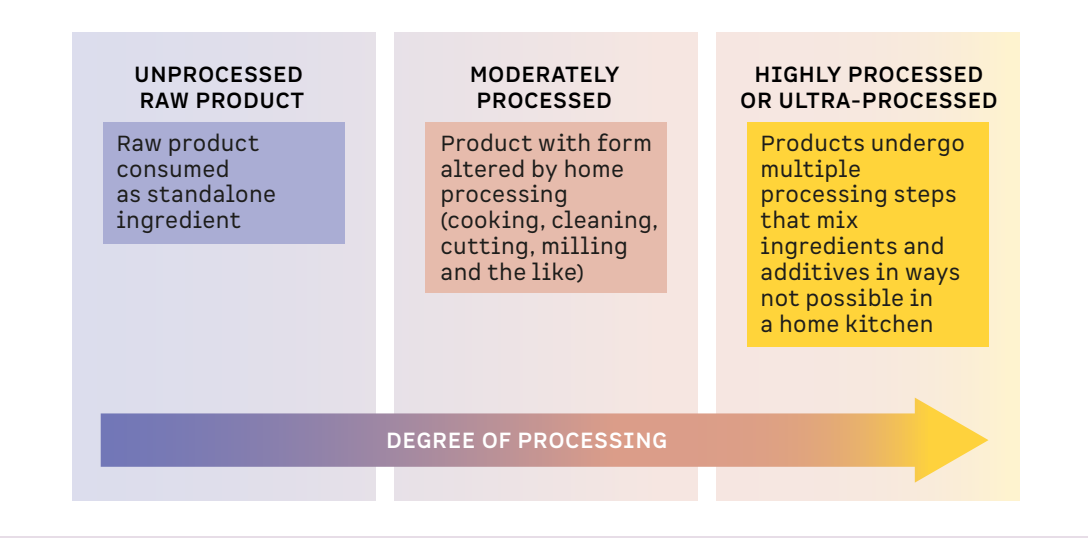
Processed food and ultra-processed food (UPF) present both opportunities and challenges for food system transformation (**BOX 7.1**). Generally, as people become more urban and incomes rise, processed foods make up a growing share of diets. This evolution has some positive effects: food processing can contribute to better food safety and higher food quality. But it can also have negative effects: because more processed foods are convenient and are often less expensive, people are tempted to consume them in excess. Such overconsumption – especially of UPF – drives up health risks, increasing the incidence of overweight and obesity.

Efforts are thus needed to increase the production of processed foods, but also to manage and moderate UPF consumption. Attaining this balance depends on complex dynamics and interactions among various stakeholders in food processing, food services, and retail and consumer organizations. Policy incentives and product innovations are needed, accompanied by market regulation to create new opportunities for local entrepreneurship – and also to support balanced diets.

This chapter looks at ways to create opportunities to realize the potential for production and consumption of processed foods and UPF as part of food system transformations. How can the small-scale business potential in food processing be mobilized to improve rural and peri-urban livelihoods? What must be done to safeguard food safety and dietary quality in largely informal food markets as food processing and food services become more important? How can responsibilities for moderating the intake of processed foods be reinforced? What policy instruments are available to support responsible food processing through a conducive food environment?

BOX 7.1 FOOD PROCESSING AND ULTRA-PROCESSED FOOD

Food processing includes all the techniques and methods – chemical and physical – that producers use to transform agricultural products into edible foods. Such processes range from grinding grain for flour to the industrial methods that create convenience foods (van Boekel et al., 2010).



Processing provides important opportunities to preserve foods, to convert inedible raw materials into food and to convert difficult-to-prepare foods into nutritious and convenient forms (Haddad et al., 2018). However, a higher proportion of UPF in diets is often associated with excessive intakes of sugar, fats and salt, with negative effects on diet quality and health (Monteiro et al., 2019).

Processed foods and food-away-from-home services are becoming increasingly important in food systems, both for employment and income creation and as part of household consumption expenditures. Generally, food system transformations lead to higher rates of production and consumption of processed foods, including UPF. As this shift brings both benefits and risks, it confronts policymakers with heightened trade-offs among various desired outcomes: food systems face the challenge of balancing livelihood and business opportunities, food safety, healthy diets and sustainable market integration.

Note: The commonly used NOVA classification, which defines foods by processing intensity, defines UPF as industrial formulations, which, besides salt, sugar, oils and fats, include substances not used in culinary preparations, particularly additives to imitate sensory qualities of minimally processed foods and their culinary preparations (Monteiro et al., 2019).

The chapter develops four key messages:

1. **Food processing provides opportunities for (youth) employment, female entrepreneurship and value added generation, and needs to be supported with training programmes and investment facilities.** Local food processing becomes increasingly important to absorb labour and create value added. It creates employment and income opportunities for women and youth, both in self-employment and in wage labour. Training programmes and investment facilities will further harness the potential of food processing for entrepreneurship in rural livelihoods, and trade policies and market regulation can reinforce the competitiveness of

local small and medium-sized enterprises (SMEs) that are producers of moderately processed foods.

2. **Moderating consumers' intake of processed foods and UPF – preventing excessive consumption – is the way to counteract overweight and obesity risks.** Consumers increasingly prefer processed foods because they are more convenient, reduce food safety risk and prolong shelf life. But low prices easily lead to excessive consumption of convenience food with low nutritional content, especially by poorer households. With larger quantities and higher intensity, processed foods and UPF can become harmful. Public investments are thus needed in behavioural change communication (CHAPTER 1) and market incentives to moderate consumption: governments should enforce market transparency to enable balanced consumer choices.

3. **The food industry carries substantial responsibilities to steer UPF intake by taking charge of healthier food products and sustainable processes and practices.** The private sector is in charge of most food processing, as well as of most distribution of processed foods to their various consumer constituencies through markets and food services. Quality upgrading can be supported by investments in desired product properties (including fortification), enabling responsible product innovation strategies and supporting processes for convening private and public cooperation on transparency in food markets.

4. **Public policies and regulation can moderate UPF intake and reduce overweight and obesity risks through a conducive food environment.** Food processing offers opportunities to improve diet quality – yet the high energy, sugar, fat and salt in processed foods and UPF are associated with rising obesity in low- and middle-income countries, contributing to the triple burden of malnutrition (CHAPTER 1). To create appropriate food environments, public policies are needed that engage stakeholders in sharing responsibility for moderating UPF consumption – especially in the most vulnerable groups – and that accelerate partnerships for reducing overweight and obesity risks. To this end, economic, legal and institutional conditions must support public-private cooperation based on a mix of private-sector food innovation and public-sector food governance.

Opportunities for youth employment, female entrepreneurship and value added generation

Food processing offers significant opportunities for developing local entrepreneurship, creating employment and generating value added in rural and peri-urban areas (**BOX 7.1**). Whereas some processed foods used to be imported, direct investments and local sourcing for food processing are increasing in response to growing urban and rural market demand. Optimizing

this potential requires low barriers to entry and supportive financial services, favourable market conditions and professional training of the labour force.

Local food processing encompasses both moderately processed foods and UPF, and it includes a wide range of activities – from self-employed street vendors and small-scale businesses to larger domestic and international food companies. Local processing ranges from milling, hand-pounding and fermentation to the more sophisticated production of frozen and canned food. Many small-scale processing activities take place in rural areas close to primary production (drying, fermentation), but industrial processing requires a larger scale and higher investments and is usually located closer to urban areas (**BOX 7.2**).

Creating inclusive business and employment opportunities in food processing

The overall trend of employment in food processing varies by country income: it is fairly low in most low-income countries, rising in middle-income countries and falling in high-income countries. While food and beverage manufacturing accounts for just 3-5 per cent of food system employment across low-income eastern and southern African countries, this share increases to 25 per cent in middle-income Brazil, and it declines to 14 per cent in the high-income United States, as more employment shifts towards food services (Christiaensen, 2020). Informal SMEs dominate in all low- and middle- income countries, especially in producing moderately processed foods.

In sub-Saharan Africa, food processing today represents 30 per cent of total manufacturing sector employment, despite constituting no more than 5 per cent of food economy employment.[7] In Senegal, food processing is the largest manufacturing subsector, growing by 7.4 per cent a year between 2000 and 2010. In Niger and Nigeria, food processing accounts for nearly 50 per cent of all industrial activities, with many jobs in artisanal – and informal – SMEs. In Côte d'Ivoire, food processing has been found to be the second largest contributor to formal employment (14 per cent) and the largest contributor to formal-sector value added, while in 2012 food processing firms provided 18 per cent of agribusiness jobs even though they constituted just 4 per cent of all firms in the sector (Hebous and Tran, 2017).

Food processing offers significant employment and income opportunities to women in sub-Saharan Africa. Overall, 37 per cent of all female food economy workers are employed in off-farm segments, compared with 11 per cent of men. Women account for 83 per cent of total food manufacturing employment and 72 per cent of total food marketing employment (Allen et al., 2018). Informal employment in food processing tends to be low-skilled and labour-intensive, with low barriers to entry, so it provides inclusive opportunities. In rural areas,

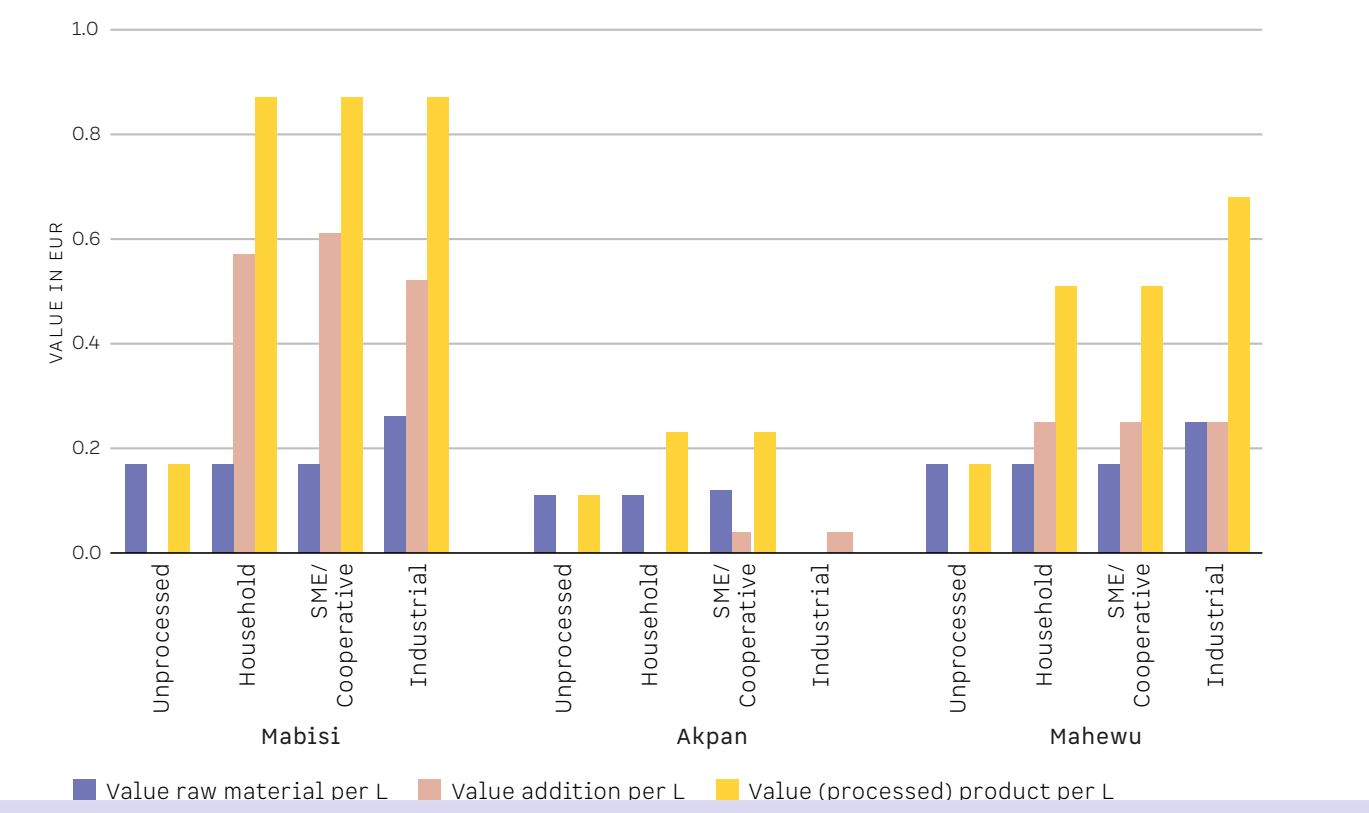
[7] Across the region, off-farm activities account for 22 per cent of total food economy employment and 31 per cent of total non-farm employment. Within the off-farm portion of the food economy, food marketing activities – transport, logistics and retail – represent the largest share of employment, at 68 per cent, followed by food processing, at 22 per cent. This 22 per cent represents 4.4 per cent of the region's food economy workforce (Allen, Heinrigs and Heo, 2018).

BOX 7.2 FERMENTED FOODS FOR LIVELIHOODS AND HEALTH – ESPECIALLY IN AFRICA

In Africa especially, the agrifood sector holds great promise for bottom-up entrepreneurship. It can create jobs, generate innovations and enable the economic and social empowerment of women and youth. Many local and traditional foods are nutritious and attractive to many, yet have not reached a wider market because processing is small-scale and value chains are lacking. Among local foods, traditional fermented foods are of special interest.

Fermentation is an ancient processing technique that relies on microbial activity to transform raw materials into attractive products with greater food safety, improved sensory attributes, increased nutritional value and health features and higher commercial value. Small-scale fermentation activities are an especially important economic opportunity for women: entry barriers and start-up costs are low, no specific assets are needed and production can be combined with domestic responsibilities. Still, traditional fermentation remains a neglected, small-scale, and underexploited practice in many countries – a missed opportunity for food security, nutrition and livelihoods.

VALUE ADDED BY HOUSEHOLD, SMALL-SCALE AND INDUSTRIAL PROCESSING FOR THREE TRADITIONAL AFRICAN FERMENTED FOODS



Three examples of traditional fermented foods from Africa are *mabisi* (Zambia), *akpan* (Benin) and *mahewu* (Zimbabwe). These foods, which are either milk- or cereal-based, possess nutritional properties that make them highly valuable for guaranteeing food security. They also represent tradition, cultural embeddedness and identity for their consumers – and an empowerment opportunity for their producers, who are mainly women. Traditional processing by households or by SMEs and cooperatives can be at least as profitable as industrial processing.

Source: Materia et al., 2021.

women are four times more likely than men to work in off-farm segments, while food processing and food services are almost exclusively women-led activities. More generally, many food processing activities, such as milling and brewing, are located outside primary cities, in small towns and more rural areas. Employment in food processing often maintains strong forward and backward linkages with other sectors. An initiative in India for inclusive and sustainable local fish processing is discussed in **BOX 7.3**.

Food-away-from-home activities – a category that includes street food, restaurants and other catering services – generate 10 per cent of off-farm food economy employment in sub-Saharan Africa, or 2 per cent of all food jobs. Women account for 88 per cent of the region's total food-away-from-home employment (Allen, Heinrigs and Heo, 2018). The share of food-away-from-home activities in employment is much higher in the region's urban areas, where food marketing and food-away-from-home jobs together account for 57 per cent of all food economy jobs.[8]

BOX 7.3 POST-TSUNAMI SUSTAINABLE LIVELIHOODS IN INDIA

The fishing markets in India were devastated by the disastrous Indian Ocean tsunami in 2004. Hundreds of thousands of inhabitants in the coastal region of Tamil Nadu were displaced and left without work. Boats and equipment were destroyed, and the value chain was severely disrupted. Small-scale women processors were unable to obtain the capital to kick-start their businesses and optimize processing activities. Tamil Nadu is the fourth largest contributor to the fishing industry in India, so rehabilitating this market was an essential task for rural support in the aftermath of the tsunami.

The Government of Tamil Nadu worked in collaboration with IFAD to bring support to small-scale fishers and midstream workers in the fishing industry after the tsunami. The processing industry largely employs women, a key demographic group in the region, so female processors became a target group for intervention strategies. The project was to provide sustainable coastal community activity in the fishing sector by developing enterprises and resource management systems. Expected beneficiaries included 630,000 fishers, fishing sector wage labourers, women fish processors and vendors, and other marginalized groups in Tamil Nadu.

In addition to creating 200 artificial reefs and establishing insurance plans for 35,000 small craft for small-scale fishers, project services benefited nearly 110,000 people. A large proportion of beneficiaries were women (roughly 121,000 of the 151,000 project beneficiaries). Throughout the course of the project, 72 processing facilities were created or restored, satisfying the production needs of other industries as well, such as mango pulp production and millet processing.

Source: IFAD project completion reports and impact assessments.

8 These activities are closely linked to the size of food markets, and the urban contribution to food marketing and food-away-from-home employment varies widely across countries. In Côte d'Ivoire, Ghana and Senegal, urban areas account for 66 per cent of all food marketing and food-away-from-home employment, compared with 52 per cent in Burkina Faso, Mali and Niger, more than 30 per cent in Abidjan, Cotonou and Lomé, and less than 10 per cent in Bamako, Conakry and Freetown (Bricas, Tchamda and Mouton, 2016). In India, by comparison, the food processing industry accounts for 32 per cent of the country's total food market and contributes almost 9 per cent of value added in manufacturing, while constituting 13 per cent of exports and nearly 6 per cent of industrial investment.

As youth join the labour force in sub-Saharan Africa, they predominantly enter non-agricultural sectors – especially in countries with higher education enrolment rates. Moreover, youth increasingly avoid agricultural sectors as they grow older. In Côte d'Ivoire, Ghana, Nigeria and Senegal, the share of all employment in the food system but outside agriculture is 31 per cent among those aged 15-19, rising to 67 per cent for those aged 30-34. For the same age cohorts in Burkina Faso, Mali and Niger, the employment share in the food system but outside agriculture increases from 17 per cent to 31 per cent (Christaensen, 2017).

This youth transition into non-agricultural activities is increasing in size and speed. Why? One answer is that youth are attaining higher levels of education and becoming more mobile (Christaensen, 2017). Another is that they lack access to productive agricultural resources and see little to aspire to in a life of agricultural activity. To promote employment potential and diversification, they need to be equipped with the necessary skills, and they need help from efforts to lower barriers to productive resources – barriers that are substantially higher for youth, and especially young women (Dolislager et al., 2020).

Because food processing and food services require initial investments in facilities and equipment, as well as funds to buy raw materials, local entrepreneurs in these areas can benefit from financial support (CHAPTER 6). The forms of such support may include:

- Quality upgrading of local home processing.
- Start-up grants through business incubators and accelerators.
- Long-term investment grants tailored to SMEs.

Also critical are public investments in infrastructure: stable energy supplies, safe water and road access are all preconditions for sustained business growth. These investments create opportunities to reinforce circular production, improve energy efficiency and reduce water use (CHAPTER 4).

Encouraging local sourcing through trade policies to boost competitiveness

In general, local processing and manufacturing can substantially increase the added value of commodity exports – examples include coffee, tea, cocoa, cotton and seafood. And although just 10 per cent of processed food products are now traded globally, processed foods represent a growing share of global food sales.

The manufacturing of processed foods is highly concentrated (**BOX 7.4**). Over the next five years, annual imports of food processing equipment for meat and poultry slaughtering and seafood processing, along with bakery and beverage equipment, and cooling facilities for dairy and vegetables, are expected to grow by 6.9 per cent annually (Allen, Heinrigs and Heo, 2018).

BOX 7.4 CONCENTRATION IN THE MANUFACTURING OF PROCESSED FOODS

Globally, almost 50 per cent of the food manufacturing share is controlled by just 10 transnational food and beverage companies (TFBCs), and all of these TFBCs have UPF in their portfolios (Baker et al., 2020). Regional estimates are more difficult to retrieve, especially for UPF, but indications are that TFBCs dominate regionally as well. For example, in the Asian processed food manufacturing sector, the top five food and beverage corporations are TFBCs.

For TFBCs, the most profitable option is often to source and produce processed foods in a host country, especially when the host country has the raw materials for production (Baker et al., 2020). In spite of this, exports of processed foods from high-income to low-income countries have grown in recent years – and this growth is expected to continue. For example, since 2014, exports from the United States in the category "Food Preps. & Miscellaneous Beverages" to Ghana have nearly tripled, rising from US$2.62 million to US$6.75 million. And while UPF products are not always well adapted to local preferences in low- and middle-income countries, a large share of the UPF market in countries with mostly traditional food systems is controlled by TFBCs.

Source: van Damme et al., 2021

To maintain and expand local sourcing for processed foods, local food processing needs a level playing field – a requirement that may entail constraints on multinational food companies. Such measures can combine trade policies (import tariffs, export support) with domestic market policies to enhance rural-urban linkages, including through direct sourcing contracts with smallholder farmers. In supporting local or regional procurement, trade policies can also encourage the establishment of local subsidiaries (**BOX 7.5**). In an example of trade policy to support local sourcing, in 2019 Nigeria acted to spur local dairy production by banning access to foreign currency for milk powder imports. Another policy stimulated local sorghum sourcing by large beer breweries.

Foreign direct investment (FDI) in food processing responds to outsourcing trends in manufacturing. Many global food companies – especially in drinks and dairy – have solid investments in developing countries based on proximity to consumer markets. In some cases, their initial establishment has been facilitated by free zones that offer favourable tax conditions. South-South FDI is also becoming important for leading firms in developing countries, especially as developing countries advance in regional blocs.

Finally, higher-income countries could substantially enhance local processing opportunities in low- and middle-income countries by further reducing tariff escalation for imports.

BOX 7.5 COMMERCIALIZING SMALLHOLDER DAIRIES IN KENYA

Food processing is a prime aspect of the milk value chain in Kenya. Since Kenya has a varied agricultural system, its processing industry is not reliant on imports from foreign countries for sustained business. As a result, improvements in market linkages between smallholder farmers and dairy producers and the milk processing industry can benefit both sectors if done properly. Projects focused on enhancing these market linkages and commercializing the activities of smallholder producers will benefit the livelihoods of all members.

The commercialization project sought to support rural smallholder farmers in various stages of the production cycle and producer activities. It was implemented to enhance the entire milk value chain through building the organizational and enterprise capacity of beneficiaries, providing technical support for business endeavours and providing market-driven commercialization strategies. Milk processing beneficiaries were also to receive additional support through technical skills training and market-driven commercialization strategies. Introducing lower-cost technologies for manure processing would provide smallholder farmers with more suitable access to the processing industry through market linkages.

Project farmers showed a significant increase in the probability for receiving information on milk processing and quality control. The number of field days, extension visits and demonstrations for dairy value chain workers increased by 18 per cent, 14 per cent and 12 per cent, respectively. Dairy groups that were part of the project benefited from increased access to investment grants for milk processing plants, and eight milk cooling or processing facilities were established. Processing became more integrated into the value chain, and market linkages between numerous production and midstream activities within the dairy value chain were bolstered. The role of the private sector became more pronounced as well: two of the largest dairy processing firms offered marketing and technical support to project dairy groups.

Source: IFAD project completion reports and impact assessments.

Supporting livelihood generation through education and labour force training

Education and labour force training enable the engagement of youth in non-farm processing activities. While jobs in food services require little education, food processing demands greater technical and commercial capacities. On-the-job training facilities, professional education and workforce employment standards are useful for improving food quality, enhancing labour productivity and safeguarding decent employment conditions (including a living wage).

Training in food processing can open up opportunities for individuals who lack business experience, providing them with skills such as product costing and marketing. High returns can also be reaped from technical and professional training in resource use, novel product design, handling, food safety and hygiene, shelf life extension and waste management. Labour legislation and workforce training can help upgrade industrial quality and productivity.

Training in food hygiene and safe food handling is critical, enabling handlers and vendors to control the spread of foodborne illnesses. Such training is affordable and can significantly change food safety knowledge and practices. But market incentives are also needed to encourage the full

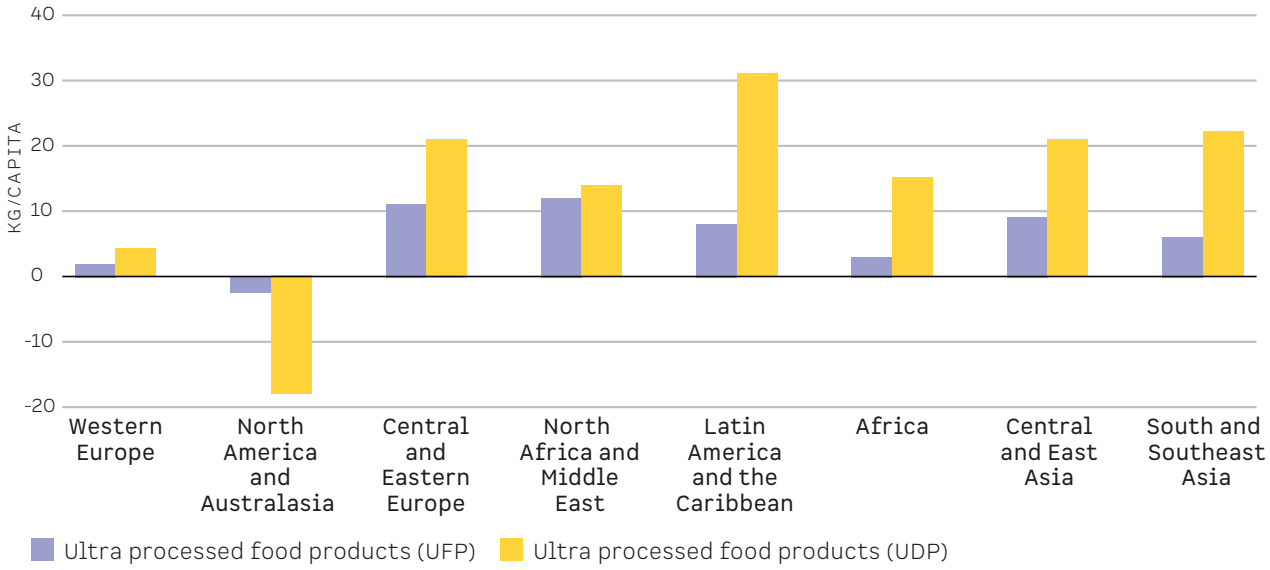
adoption of good hygiene practices – and their adoption will increase food prices (Choudhury et al., 2011).

Training in new processes – such as hazard analysis and critical control points and the labelling of quality assured food products – generally yields results. Far less successful are infrastructure investments, routine control and inspection systems, and organizational innovation. Legal enforcement tends to falter, as street vendors are harassed by authorities and forced to pay bribes. Moreover, actions to penalize street foods may reduce food access (Randolph, 2021).

Improving nutritional content and moderating consumption

Consumer demand for processed foods and UPF is rising rapidly, thanks largely to their convenience, safety and extended shelf life. Yet the potential nutrition and health risks of UPF consumption make moderating their intake an urgent priority. Over the period 2002-2016, total per capita sales of both UPF and ultra-processed drinks rose substantially in low- and middle-income countries (**FIGURE 7.1**).

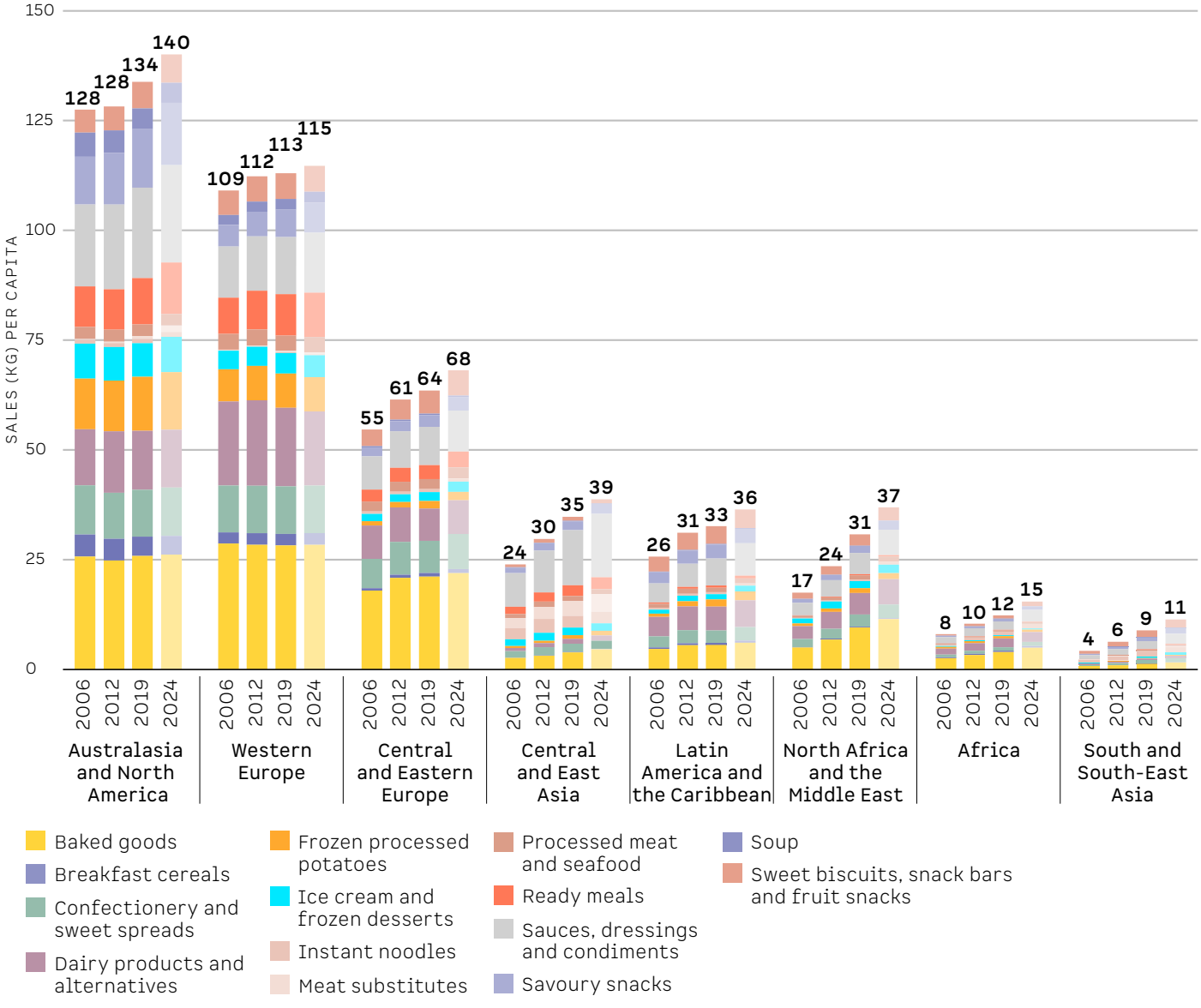
FIGURE 7.1 CHANGE IN TOTAL VOLUME SALES PER CAPITA OF ULTRA-PROCESSED FOOD AND ULTRA-PROCESSED DRINKS, 2002-2016



Source: Global Panel on Agriculture and Food Systems for Nutrition, 2020.

In 2005, global sales of processed foods – including UPF – were already estimated to make up around three quarters of total annual food sales (Gehlhar and Regmi, 2005). In the 15 years since, the sale and consumption of ultra-processed food and drinks have risen in every area of the world: a trend that is projected to continue (**FIGURE 7.2**). Improved market connectivity and rising prosperity also lead to higher UPF consumption in marginal rural areas. Among the most important processed food products are pasta; bread; chicken and beef broth; canned food; salted, dried or oil-preserved fish and meat; and beer, soft drinks and wine.

FIGURE 7.2 PER CAPITA ULTRA-PROCESSED FOOD SALES BY REGION, 2006-2019, WITH PROJECTIONS TO 2024



Source: Baker et al., 2020.

While the transition to a modern food system typically results in an increase in intake of processed foods and UPF, consumption patterns vary regionally. These regional variations reflect differences in diets and culture, economic and social development (including education), degrees of urbanization, and market and governance structures. Per capita UPF sales are growing most rapidly in Africa, Asia and Latin America (see **FIGURE 7.2**). The fastest sales growth appears in frozen products, snacks and soft drinks, followed by baked goods, sauces and snacks. Total sales are highest in high-income countries (where they are levelling off).

Data on the share of total energy intake from UPF are available only for certain countries. In Brazil, Chile and Mexico, UPF delivers about 30 per cent of per capita daily energy intake. In the United Kingdom, this share rises to 50 per cent, and in the United States to 60 per cent (van Damme et al., 2021). The largest energy providers are baked goods, burgers, pizzas, sandwiches, frozen dishes, mass-produced packaged breads and sweetened milk-based products. In Asia, dried processed foods and carbonated soft drinks account for more than half of UPF sales (Baker and Friel, 2016).

The rise in processed food and UPF intake generally reflects increasing incomes and rapid urbanization: processed foods and sugary soft drinks are readily available at fairly low prices from corner shops, supermarkets, out-of-home food service providers and fast-food chains. A clear difference appears between rural and urban consumption of highly processed foods (**TABLE 7.1**). In Asian countries, including Indonesia, Nepal and Viet Nam, urban consumers spend 32-38 per cent of their total food budget on highly processed items, compared with 17-22 per cent for rural consumers. Similarly, a Chilean study found that UPF provided 29.3 per cent of the energy intake in urban areas but 23.7 per cent in rural areas (Cediel et al., 2018). In Kenya and Tanzania, average per capita daily energy intake from processed foods and meals consumed outside the home was 800 kcal in urban areas and 300 kcal in rural ones (Cockx et al., 2019).

TABLE 7.1 SHARE OF HIGHLY PROCESSED FOODS IN TOTAL FOOD EXPENDITURE, 2010

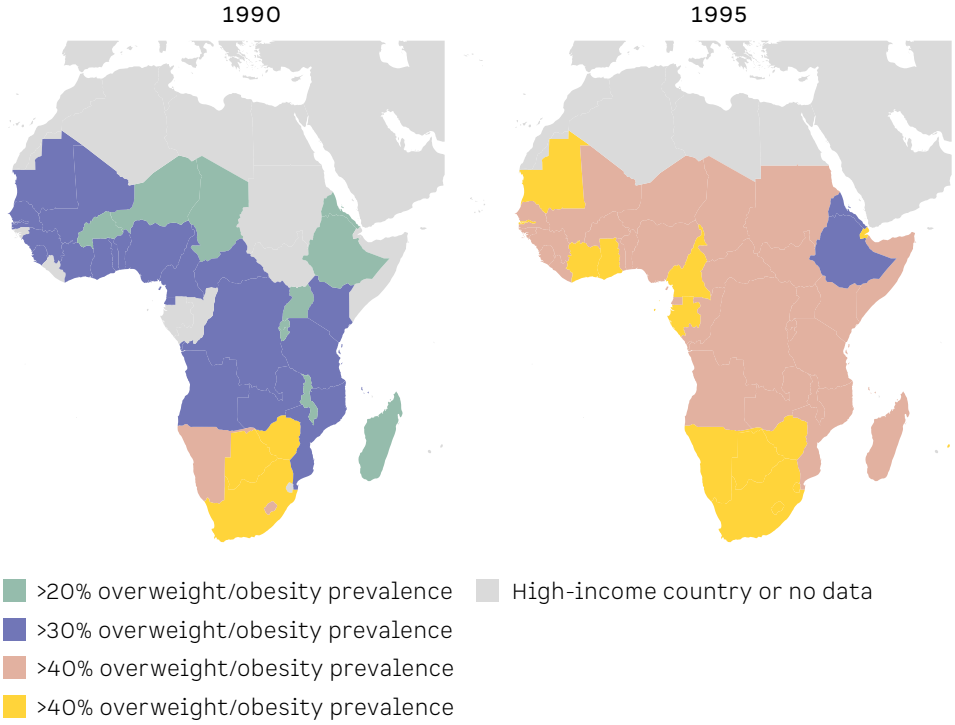
COUNTRY	SHARE OF HIGHLY PROCESSED FOODS AS A PERCENTAGE OF TOTAL FOOD EXPENDITURE IN VALUE TERMS (%)	
	RURAL	URBAN
Bangladesh	13.4	17.7
Indonesia	22.7	34.2
Nepal	17.0	36.7
Viet Nam	17.6	32.4

Source: Reardon and Timmer, 2014.

While the nutritional quality of processed foods varies widely, most UPF is energy-dense with lower diet quality due to high amounts of refined grains, added sugars and fat (Monteiro et al., 2019). If UPF is not nutritionally balanced, its consumption increases overweight and obesity rates (da Costa Louzada et al., 2015; Monteiro et al., 2019). The high energy density and low fibre content of much UPF tends to encourage overeating – yet it often lacks essential nutrients, causing a diffuse "hidden hunger". As a result, even though the cheaper calories provided by UPF may benefit poor and undernourished people, they also contribute to the double burden of malnutrition (Traill, 2017). The prevalence of overweight and obesity in sub-Saharan Africa has increased rapidly since the 1990s (**FIGURE 7.3**).

From a consumer perspective, UPF can be attractive because of taste and convenience – and can save time, especially for women. In addition, a more diverse diet reduces the risk of inadequate nutrient intake: in rural African populations, introducing some UPF could improve the diversity and energy content of certain diets (Ferguson et al., 1993). Recently, research from sub-Saharan Africa has even indicated that the presence of UPF can mitigate underweight prevalence (Boysen et al., 2019). The possibility of fortifying food with appropriate micronutrients is one of the major advantages associated with industrial food processing.

FIGURE 7.3 PREVALENCE OF OVERWEIGHT/OBESITY IN LOW- AND MIDDLE-INCOME SUB-SAHARAN AFRICAN COUNTRIES



Source: Reardon et al., 2021, based on 1990s and 2010s weight and height data from Demographic and Health Surveys.

For policy, the challenge is to do two things at once: mitigate the risk that increased UPF consumption will lead to unbalanced diets and raise poor people's overweight and obesity rates, and balance this risk against the wider advantages of processed foods. Attaining this balance requires attention to consumer education, food market transparency and outlet regulation, and food quality surveillance systems – all detailed below.

Enacting rules for convenience, ingredients and meal size to moderate UPF intake

The rising intake of UPF reflects increasing purchases of foods in supermarkets and corner shops, along with an increase in away-from-home and fast-food consumption (Reardon et al., 2021). As a result of rising intake, diets are increasingly energy-dense and low in fibre. In addition, eating rates are generally higher for UPF than for unprocessed foods: energy intake from UPF is more than 50 per cent greater, explaining the link between ultra-processed diets and excess calorie intake leading to weight gain (Hall et al., 2019). Changing this behaviour requires strictly enforced rules to limit the purchase of UPF products, regulate the use of harmful ingredients and balance meals.

Policies to keep UPF consumption within reasonable boundaries can target convenience, meal content and meal size. For example:

- **Convenience.** Limit shelf space for UPF, and mandate responsible design of retail shops and supermarket outlets to influence convenience and choice (no sweets at cashiers and fresh fruits at shop entry).
- **Meal content.** Regulate the use of particular ingredients, including through authorization procedures for food additives, food enzymes and food flavourings.
- **Meal size.** Downsize meal and snack portions to reduce overeating risks.

The prospects for compliance with UPF regulations are generally good, given the importance of large-scale processors, the dominance of transnational food and beverage corporations (which control more than half of food manufacturing) and the international scale of fast-food chains.

Food fortification has proven feasible as a supplementary strategy for improving UPF nutritional quality. Because people eat staple foods daily, the easiest way to boost nutrition is to fortify such foods with iron, zinc, iodine, vitamin A and folic acid (Venkatesh Mannar and Hurrell, 2018). Food fortification is especially effective at reducing micronutrient deficiencies.

Not all vulnerable people can be reached through food fortification, however. And absorption is sometimes limited. Thus, food fortification must be accompanied with improved diets.

To reduce harmful ingredients and improve nutrient content in frozen, canned and packaged foods, it is generally necessary to reduce the amount of added salt, sugar and fats. Other promising strategies rely on innovative technologies, however. Examples include:

- Starch chemistry modification.
- Naturally derived non-caloric sweeteners.
- Fat-reducing food preparation processes.
- Novel water-soluble fibres (Weaver et al., 2014).
- Targeted biodelivery of antioxidants and other bioactive compounds through nanotechnology.

Unfortunately, many of these technologies are more available to transnational food and beverage companies than they are to local informal-sector enterprises.

Consumer education can help to moderate UPF intake in various socio-economic groups. Moderating UPF consumption is important to avoid the risks of overweight and diabetes. Both information access and social norms are critical for steering consumer behaviour (CHAPTER 1). Consumer education campaigns can guide food choices in desired directions and inform consumers about the health prospects and risks associated with different types of food products.

Over the last two decades, a growing number of countries have developed country-specific food-based dietary guidelines that embody national nutrition recommendations and express the principles of nutrition education in terms of food. A study of 83 guidelines showed that most recommend lowering the consumption of sugars and salt, which are present predominantly in processed foods (Haddad et al., 2016). In some countries, the guidelines explicitly recommend avoiding UPF that is high in fats, sugars and salt. While other guidelines are less explicit, many advocate consumption of whole, raw or unprocessed foods. The advice to limit highly processed foods was the fourth most common limitation message, after recommendations to limit salt, fat and sugar intake (Herforth et al., 2019).

As detailed in CHAPTER 1, nutrition education is key to strategies that target lifestyle behaviour (Baker et al., 2020). It improves dietary quality and awareness. In Trinidad and Tobago, school education interventions reduced intake levels for fried foods, soft drinks and snacks high in fat, sugar and salt (Francis, Nichols and Dalrymple, 2010). In Brazil, education interventions were especially effective in reducing soft drink consumption (James et al., 2004).

Ensuring that institutional procurement programmes use food quality surveillance to limit health risks from UPF intake

Food quality norms in institutional procurement programmes can enforce the selective intake of UPF. Organized programmes for providing meals in schools, workplace canteens, hospitals and prisons need to obey strict rules

regarding food composition, diet quality and origin. In addition, responsible authorities should monitor and control the content of canned and processed food distributed under social safety net programmes (food or cash for work) targeted towards vulnerable households, women and children.

The food industry can – and must – act in various ways to support responsible food processing

Both at the international level and at the national level, the food industry carries a substantial responsibility to guarantee that food manufacturing contributes to healthy and affordable products and balanced and sustainable diets. Investments in product, process and system innovations need to be aligned with dietary requirements and sustainable sourcing principles. The private sector's engagement in food processing, packaging, marketing and sales can be shaped in several ways:

- By investing in healthier, more convenient food and upgrading product properties.
- Through business innovation strategies at the enterprise or value chain level.
- With sector-wide initiatives to influence norms on consumption, develop common standards for more sustainable food manufacturing and reduce waste.

Improving product properties

Food and beverage companies are working on technical innovations to make processed foods and UPF healthier and more sustainable. Indeed, food processing accounts for more than half of private spending on food- and agriculture-related research and development (R&D) (Fuglie, 2016). These private R&D expenditures influence the types of processed foods that will become available in the coming decades, as food is produced, processed and packaged in new ways to make it safer, healthier, more nutritious or more delicious.

As firms set priorities for R&D investments, they seek technical improvements that affect attractiveness, affordability, product safety and shelf life, as well as health, nutrition and sustainability. The potential for innovation depends on firm size (scale), gestation period and capital intensity. Multiple obstacles and uncertainties can reduce the number of product innovations that succeed, but the private sector appears responsive to changing consumer priorities.

Specific food processing innovation trajectories aim to develop or strengthen desired properties of processed foods and so improve food safety, nutritional quality and health. These trajectories are:

- Upgrading local seed systems and improving seed properties to enhance nutritional content and improve conservation potential.
- Promoting new products that advance the protein transition (insects, seaweed, microalgae, meat substitutes) while supporting the bioeconomy.
- Scaling biological control measures to combat aflatoxins and to reduce moisture in food storage.
- Exploiting opportunities for health risk reduction in food processing through hazard analysis and critical control points.
- Designing contract farming arrangements that prescribe product properties for processing (tomatoes for pasta sauce, potatoes for chips and French fries) or that regulate UPF ingredients.

To control overweight risk, the world must reduce oil, saturated fat, salt and sugar content in processed foods and beverages. Over 1961-2014, global palm oil production rose from less than 5 million to 50 million tons, around 70 per cent of it for food manufacturing. Beet sugar and sugar cane production also vastly increased, from 53 million to 177 million tons. High-fructose corn syrup constitutes almost 100 per cent of caloric sweeteners added to foods and beverages (Baker et al., 2020). Reducing these components in processed foods yields large health and environmental benefits.

Innovations for healthier and more sustainable diets are emerging in biotechnology, in functional foods and in nanotechnology, and will be put to use in food products.

Innovations for healthier and more sustainable diets are emerging in biotechnology, in functional foods and in nanotechnology (packaging), and will be put to use in food products. In addition, highly disruptive food innovations are expected in alternative proteins, food sensing, mobile services, insurance, blockchain, precision agriculture, microbiome technologies, gene editing, molecular biology and off-grid energy generation (WEF, 2018).

Increasing resource efficiency, traceability and shelf life through business innovation strategies

Food processing firms are also pursuing innovation opportunities to increase resource efficiency and traceability, especially through business process investments to improve shelf life and to add traceability for perishable food products. Major investments focus on better product handling (logistics, packaging and storage), on safeguarding procedures to enhance nutritional quality throughout the food chain, and on information management and data-sharing practices that are critical for inclusiveness (CHAPTER 4).

Large business investments – at both the enterprise and the value chain level – aim to prevent food waste, safeguard food safety and build competitive advantages in existing and new market segments. Some promising process innovation trajectories are:

- Improving the stability, safety and quality of locally processed foods (see **BOX 7.2**).
- Investing in process innovation, such as facilities for drying, freezing, cooling and heating.
- Improving logistics and biodegradable packaging to safeguard product quality during transport and storage.
- Promoting better supply chain integration using novel ICTs (blockchain) for chain transparency.
- Using digital facilities for fast information sharing (real-time sensors) and improving financial transactions.

Supporting precompetitive activities through sector-wide initiatives towards common standards

Sector-wide initiatives to make processed food healthier, safer and more sustainable include product standard harmonization, common agreements on packaging and a global framework to reduce losses and align with global reporting standards. Broad business participation in these networks is critical to uphold their legitimacy and authority. Firms also increasingly self-regulate on norms relating to restricted advertising, and guarantees with regard to customer data management are also becoming more important.

Some important sector-wide initiatives in the food processing area are:

- Global reporting standards for responsible business management practices.
- A framework for sustainable packaging and waste reduction.
- A regulatory framework for big data management (privacy rules).
- Voluntary restrictions on marketing and advertising.
- Operating licences and tax regulation for international agribusinesses.

Reducing health risks by establishing a conducive food environment

Public policies and regulation – developed and enforced through governance processes involving all stakeholders – can support a conducive food environment. Such an environment induces healthy consumption of processed and ultra-processed food by the most vulnerable consumer groups: poor households, ethnic minorities, pregnant women and adolescents, among others. Features of a conducive food environment for moderating UPF intake include:

- Taxes and levies on UPF.
- Public, private and voluntary systems of grades and standards.
- Market facilities for specific food delivery channels.
- Public-private interfaces that support stakeholder cooperation on moderating UPF intake.

Using taxes and tariffs

Domestic levies and taxes support sustainable consumption of processed foods. Also promising are import tariffs levied on UPF (Boysen et al., 2019) to limit consumption and reduce obesity rates.

In sub-Saharan Africa, an increase of one percentage point in UPF tariffs is expected to reduce obesity prevalence by 0.18 per cent – though it is also likely to increase underweight prevalence by 0.05 per cent. In Mexico, a tax in force since 2014 has proved effective in reducing soft drink consumption. The years since then have seen households at the lowest socio-economic level reduce their purchases of taxed beverages by the biggest margins (Colchero et al., 2017).

Using public, private and voluntary systems of grades, labels and standards

Grades and standards shed light on the social and environmental effects of food production and product formulation. Information on product quality at the outlet level favours more balanced UPF consumption. Market transparency also helps consumers reduce UPF intake, especially from supermarket purchases and from out-of-home meals. For packaged UPF products and fast-food meals, both voluntary and obligatory product information and product labelling (positive and negative) can support healthier consumer choices. Some examples are:

Market transparency helps consumers reduce UPF intake, especially from supermarket purchases and from out-of-home meals.

- Marketing rules and food labelling for products posing health risks from excessive intake – in Chile, warning labels are obligatory for products that exceed a certain level of sugar, sodium, saturated fats or calories, and these products may not be advertised to those under the age of 14.
- Voluntary certification and labelling for the use of sustainable production methods, the payment of fair prices and the payment of a living wage – often used for tropical commodities.
- Public standards with industry guidance on reducing plastic packaging or reusing plastic.
- Obligatory nutrition scores on processed foods.
- Regulation of advertisements for particular foods (infant food) and those directed at specific consumer groups (adolescents, pregnant women).

Labelling and certification aim to reduce or optimize the intake of selected nutrients and to influence industry practices – for example, to reduce a product's content of unhealthy compounds, such as salt and trans fats, or to add healthy components, such as protein and micronutrients (Shangguan et al., 2019). So far, labelling rules have had larger effects on product formulation by the food industry than on consumer choices. Even so, labelling and certification can help consumers make better choices – if the information is available and clear.

Using market facilities for specific food delivery channels to widen access to more balanced diets

Ultra-processed food is delivered through a wide number of market channels, mainly supermarkets and corner shops, home delivery (courier services) and out-of-home consumption. Important market facilities to regulate both formal and informal food markets include entry permits, operating licences and sanitary controls. In addition, opportunities exist to upgrade food services and widen access to more balanced diets by training chefs and improving menus.

With increased use of the internet and mobile devices, app-based services that enable personalized nutrition and home delivery can support balanced diets.

With increased use of the internet and mobile devices, app-based services that enable personalized nutrition and home delivery can support balanced diets. For example, services can deliver information on product properties and promote access to higher-quality diets tailored to individual needs. Digital market spaces can also expand access to ingredients, and they can target various consumer categories with tailor-made offers.

Using public-private interfaces to support stakeholder cooperation for a collaborative food environment

Given the high number and wide diversity in scale and degree of informality of businesses involved in food processing, a key principle for improving the food environment is to create conditions for compliance based on voluntary cooperation and countervailing power. To align stakeholders and to support collective action, four elements will be essential:

- Civic empowerment through consumer associations and interest groups.
- Engagement of interested outside actors (for example, health insurance companies).
- Learning platforms and value chain partnerships.
- Due diligence practices and self-regulation by the food industry.

It is increasingly clear that no single policy on UPF will achieve desired food system outcomes through universal application: one size does not fit all. To support responsible food processing and moderate UPF intake, consumer incentives must be combined with production facilities and market

restrictions. Policy negotiation must seek a supportive regulatory framework, along with pricing and taxation measures to enhance business innovation, and information provision requirements to nudge consumers towards more balanced dietary choices (WEF and McKinsey, 2020).

Policy priorities for local food processing

Food processing offers important opportunities for off-farm employment and rural entrepreneurship, and it can contribute to safer, affordable and diversified diets. But it is equally important to protect households from UPF intake that exceeds healthy levels.

Policies to steer the production and consumption of processed foods and UPF need to combine local engagement in small-scale business, affordable technologies, and supportive price and non-price incentives. In the earlier stages, attention should focus mostly on business development and market entry facilities. In the later stages, taxation and legal regulation are required to safeguard an equitable and balanced food processing sector. The most advanced food systems need to embrace engagement in public-private partnerships and reliance on voluntary standards as leading governance principles.

Policies to support healthy, inclusive and sustainable food processing should focus on three objectives:

- Facilitate small-scale local food processing industries that provide new bottom-of-the-pyramid business and employment opportunities – especially for women and youth – and that increase access to a wider variety of food products.
- Support the moderate intake of processed foods and UPF through incentives for responsible business innovation processes and standard-setting facilities for the food environment – because producers are most likely to respond positively to a combination of enabling and constraining incentives.
- Promote effective public-private interfaces to support a conducive food environment, based on clear guidance and behavioural change communication, to encourage moderate UPF intake by disadvantaged groups and prevent excessive UPF intake, especially through global self-regulation by firms engaged in UPF supply and marketing.

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ANNEX 1
Simulating the trade-offs and outcomes of food system interventions using the MAGNET model

Food systems provide livelihoods to some 3 billion people who are directly engaged in farming or work in agroprocessing, rural banking or retail, whether self-employed or as temporary or permanent workers. Food systems also provide food and nutrition to people, both in rural and in urban (including peri-urban) areas. This double role of food production – as a source of income and a cost of living – implies that transforming food systems must pay due attention to the different and overlapping roles and interests of farmers, traders and consumers. Optimizing the potential of food systems to support equitable rural livelihoods requires a focus on the upstream, midstream and downstream linkages. But it also requires attending to the potential trade-offs with other food system outcomes.

Policies thus need to address likely trade-offs between outcomes for nutrition, inclusiveness, sustainability and growth. The report's MAGNET[1] analyses of alternative future food system transformation strategies, with a horizon to 2050, provide insights into opportunities and constraints for reaching nutrition, inclusiveness and sustainability goals simultaneously and in an economically efficient and socially just manner. Different extreme scenarios show possible outcomes that take account of interactions – both positive and negative – between changes in production and in consumption through adjustments in trade flows, input and factor use, wages, profits and prices.

1 MAGNET stands for Modular Applied GeNeral Equilibrium Tool.

Assessing the potential impact of policy changes using stylized food system modelling

The MAGNET modelling framework generates simulations of the impact of major policy shifts on four key food system dimensions: nutrition, inclusiveness, efficiency and sustainability, defined by 28 indicators that broadly measure progress in SDG performance (**TABLE A1.1**). Changes in these 28 indicators due to targeted policy incentives are reported consistently – to enable comparisons across simulated interventions, and to keep overall food system impacts in view when diving more deeply into parts of the food system.

TABLE A1.1 MAGNET FOOD SYSTEM INDICATORS

NUTRITION	INCLUSIVENESS
Share of calories from non-cereals (N1)	Lowest skilled agricultural wage/cereal price (I1)
Fruit and vegetable consumption (N2)	Lowest skilled agricultural wage/healthy diet cost (I2)
Shannon diversity index of diet (N3)	Lowest skilled wage/other wages (economy-wide) (I3)
Poultry-fish/red meat consumption (N4)	Lowest skilled agricultural wage/lowest skilled non-agricultural wage (I4)
Vitamin A (N5)	Lowest skilled non-agricultural share in employment (I5)
Zinc (N6)	Labour share in GDP (I6)
Perishables with food safety risks (fruits, vegetables and animal products) (N7)	One minus labour-based GINI (I7)
SUSTAINABILITY	**ECONOMY**
Agricultural land area (S1)	Structural transformation: shares of non-agricultural value added (E1)
Pasture land area (S2)	Rural transformation: agricultural-value-added per worker (E2)
Shannon diversity index of crop land use (S3)	Agricultural employment (E3)
Total abstracted irrigated water (S4)	Food supply chain employment (E4)
Wild fish/aquaculture production (S5)	Food self-sufficiency rate (E5)
GHG emissions by agricultural sectors (S6)	Food price (index) (E6)
Total GHG emissions (production sectors + final demand) (S7)	Non-food share in household expenditures (E7)

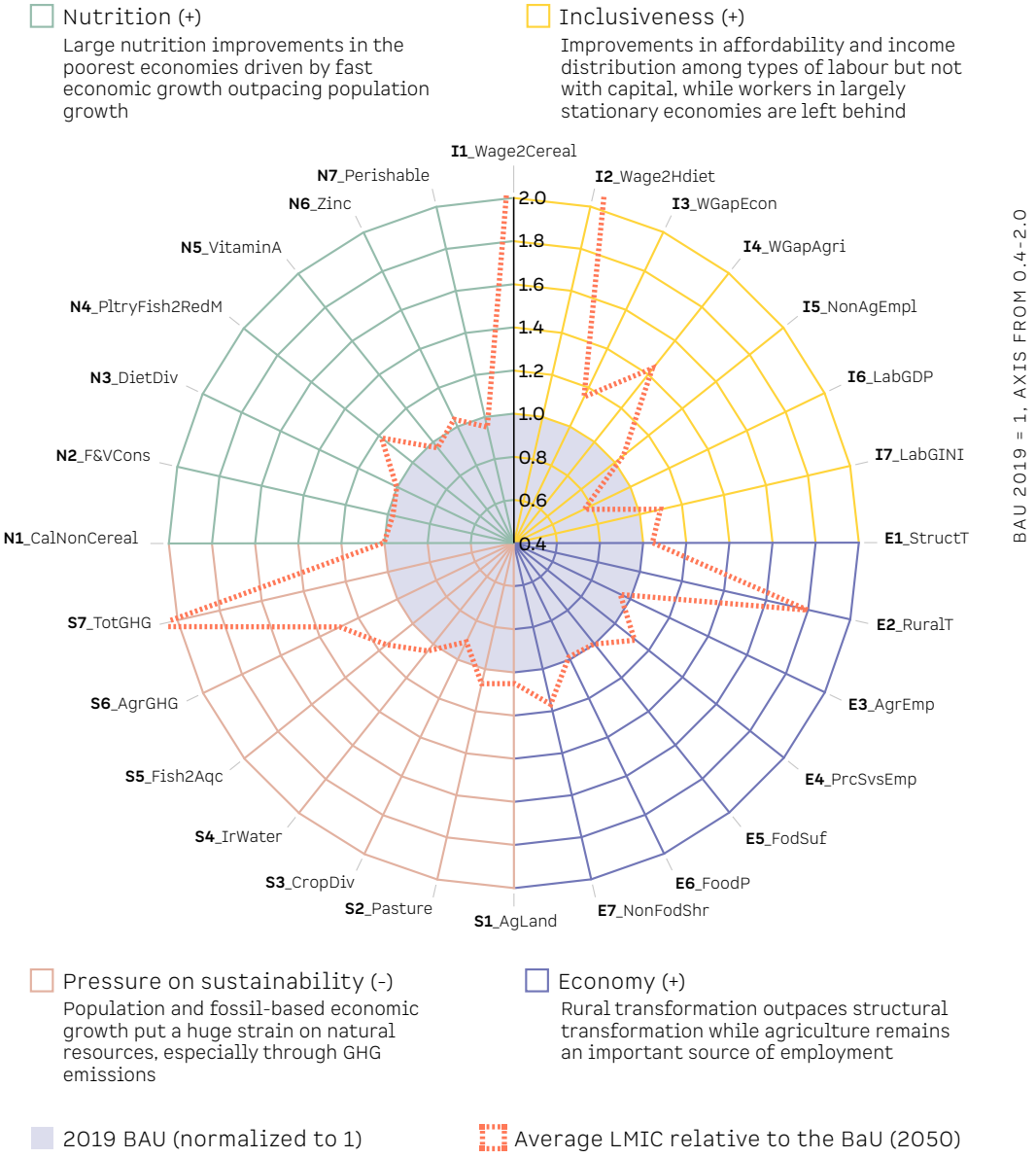
The simulations generate average impacts based on data for 71 low- and middle-income countries. Additional details are available in Kuiper and Verma (2021), where these 71 countries are grouped using a similar approach, based on the degree of structural transformation (ST) and rural transformation (RT) but using MAGNET-specific data and thresholds. In addition, differences between economies are based on projected rates of economic growth from 2019 to 2050 to highlight changes in the poorest but fastest-growing subgroups within the ST-RT grouping when these differ substantially from the average impacts in low- and middle-income countries.

The business-as-usual (BaU) scenario is the reference for the foresight results throughout the report, serving as background to judge different types of food system interventions. It captures the projected food system changes from 2019 to 2050 resulting from key macro drivers, such as population growth, technology changes, total factor productivity, and labour force composition. Details on the technical set-up of all scenarios are available in Kuiper and Verma (2021).

To identify food system transformation challenges beyond the current Sustainable Development Goal (SDG) framework – and to show the costs of inaction – the foresight analysis takes a time horizon to 2050. Simulation outcomes suggest the need for accelerating efforts to approach the SDG targets. Note that it is not yet possible to account for the effects of COVID-19, since its long-run impacts are not yet clear enough to be reflected in the growth paths, which could be substantially lower than those in the current middle-of-the-road simulation.

The business-as-usual baseline

FIGURE A1.1 THE BASELINE – CONTINUING WITH BUSINESS AS USUAL, 2019 TO 2050



Source: Kuiper and Verma, 2021.

In all figures, the grey circle represents the 2019 reference point – for the 2050 BaU scores for all counterfactual scenarios in the simulations – with the value of each of the 28 indicators normalized at 1. The dashed line then presents the change for each indicator relative to this uniform reference point. Movements outward are judged as positive in the nutrition, inclusiveness and economy quadrants. The labour-based GINI indicator, for example, is defined so that an increase signals greater equality of wage incomes. Only in the sustainability quadrant is an outward movement judged as negative, signalling increased pressure on natural resources. An increase in total GHG emissions, for example, increases the rate of climate change.

The BaU scenario indicates that economic development is likely to be accompanied by some progress in nutrition (particularly in the more diversified economies), but with strong negative implications for the natural resource base. Land use will be reaching its limits and more intensive agricultural production leads to higher emissions. Economic growth translates into higher per capita income, and labour transfers out of agriculture to higher paying non-agricultural jobs contribute to declining wage inequalities.

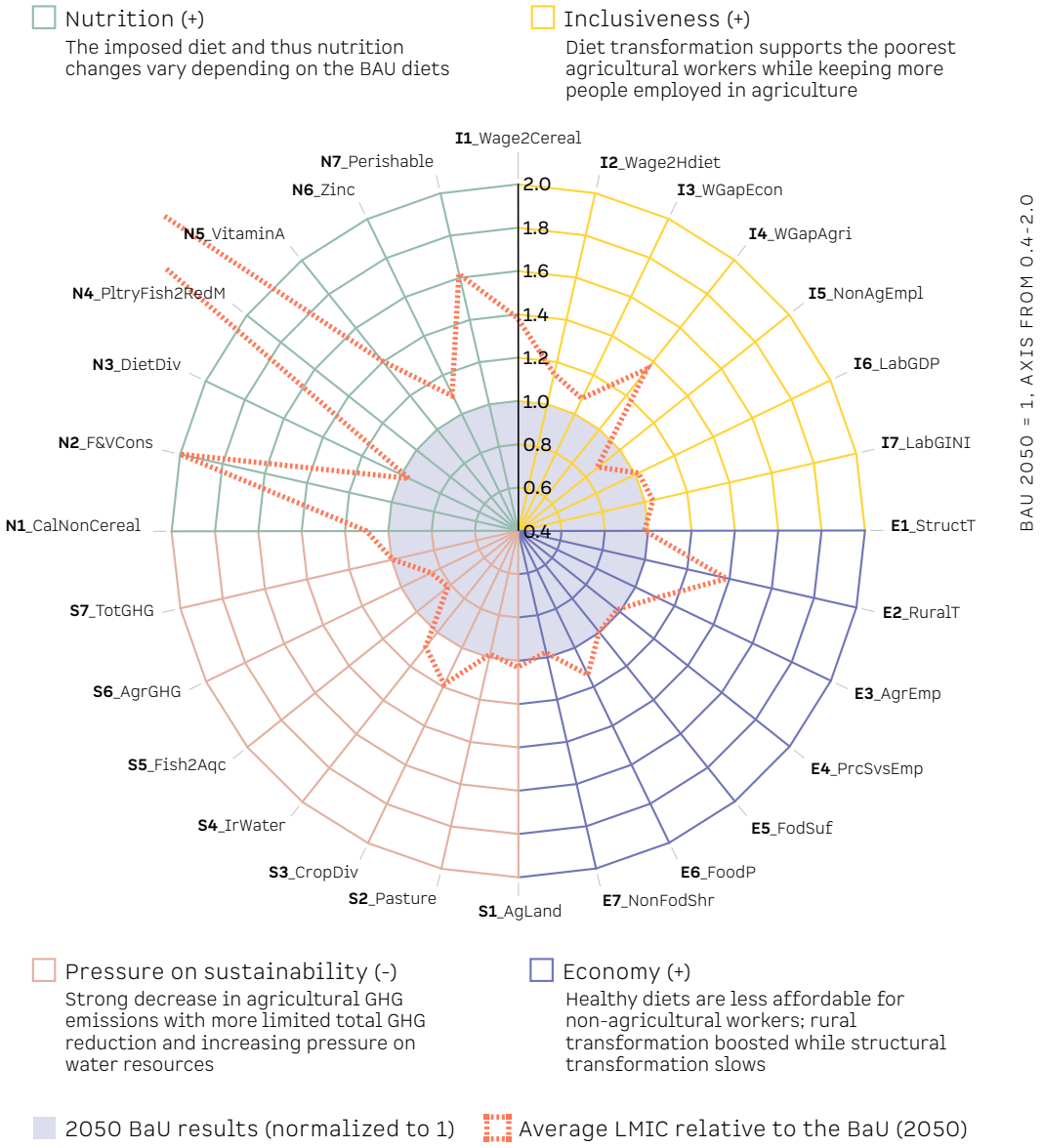
Simulation 1 Imposing a flexitarian diet

A healthy and sustainable diet supports the poorest agricultural workers while keeping more people in agriculture and increasing food prices

One option for fundamental food system changes is a global shift to a healthy and sustainable diet. The diet scenario uses a flexitarian healthy diet derived from Springmann et al. (2018) and designed to simultaneously reduce GHG emissions and diet-related non-communicable diseases. The diet is imposed in MAGNET through a preference shift, altering the demand system such that households consume the flexitarian diet irrespective of prices or income.

By design, the nutrition indicators improve strongly, while agricultural GHG emissions (S6) contract as meat consumption is restricted. The reduction in total GHG emissions (S7) including non-agricultural sectors is much more moderate, signalling considerable leakage of GHG reductions as households change their expenditure patterns. Following the reorientation towards more plant-based diets, pastures contract (S2) but total agricultural land (S1) and use of irrigation water expand (S4).

FIGURE A1.2 IMPOSING A FLEXITARIAN DIET



Source: Kuiper and Verma, 2021.

While inclusiveness is not part of the diet rationale, its stimulus to primary production increases demand for low-skilled agricultural labour (a core input in agricultural production in low- and middle-countries) raising its wage. As a result, the wage gap between low-skilled workers and all other workers (I3) and low-skilled non-agricultural workers (I4) closes, pulling more workers into agriculture (I5). Affordability of both cereals (I1) and a healthy diet (I2) improves as the agricultural wage increases of low-skilled workers outpace food price increases (E6). Despite wage increases for low-skilled agricultural workers, overall income inequality appears stable according to the labour share

in GDP (I6), so owners of land and capital also benefit from the diet shift. The labour-based GINI (I7), however, shows an improvement, reflecting the fact that while more people remain in agriculture, their wages are increasing relative to the wages of other workers.

The small average decrease in non-food share of household expenditures (E7) hides a much stronger decline in the poorest group of agriculture-focused economies, signalling concerns for the affordability of a healthy diet for lower-paid workers in industry and services.

Simulation 2 Doubling livestock and aquaculture feed productivity

Doubling the productivity of feed for livestock and aquaculture increases the affordability of food but increases wages gaps for the lowest skilled

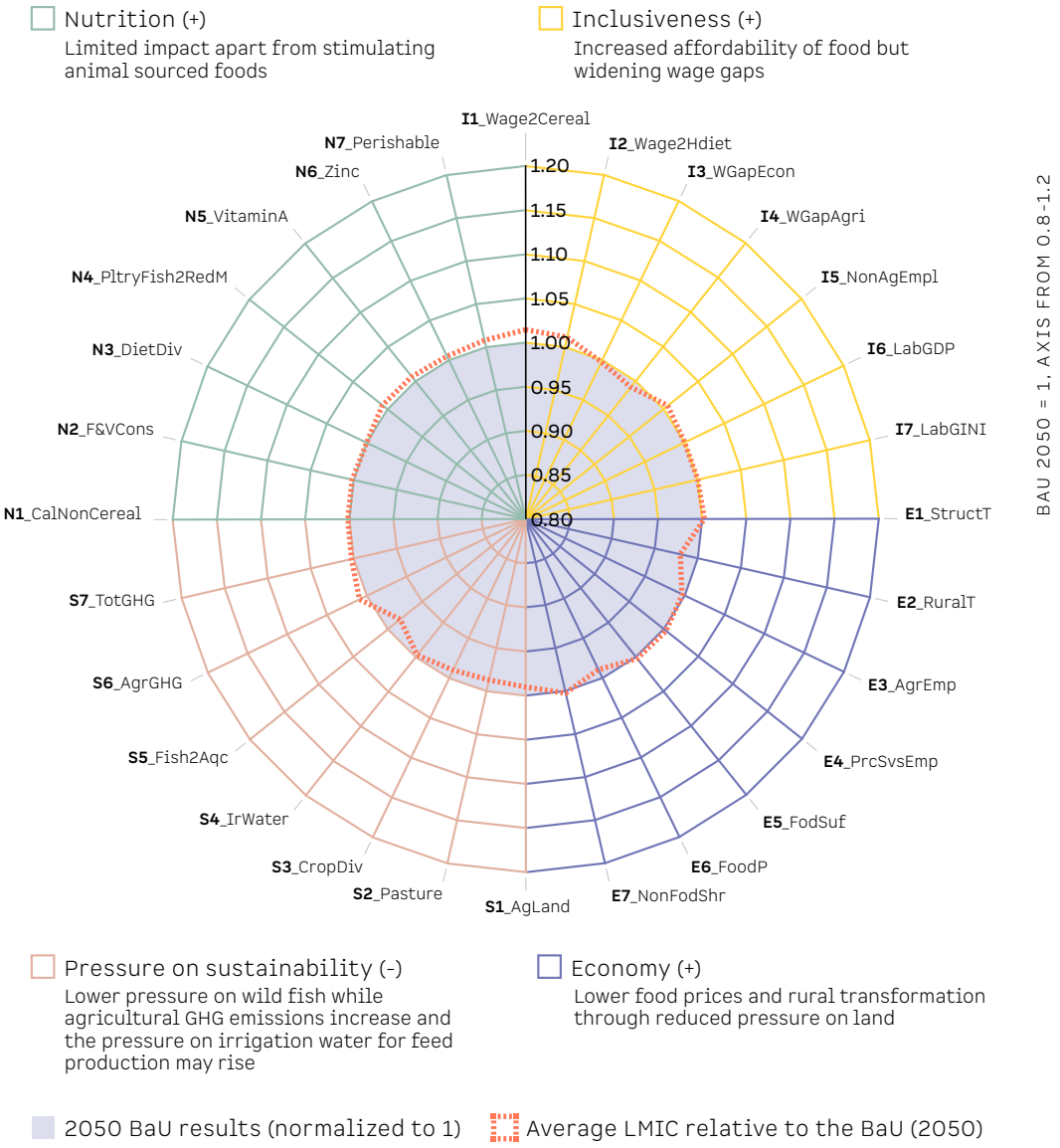
The simulation builds on the mechanisms where rising incomes increase demand for meat and fish, meanwhile increasing pressure on natural resources in the BaU. Most notable is the BaU increase in pasture area, already the largest agricultural land use category. Intensification of production may reduce pressure on land and on wild fish stocks by stimulating aquaculture. This is simulated by doubling the BaU increases in feed productivity.

Increased feed productivity stimulates livestock and aquaculture production, while reducing pressure on pastures (S2) and wild fish stocks (S5). Hidden in the average response is a much stronger contraction of pastureland in land-scarce economies already oriented towards feed use and thus well placed to benefit from the productivity increase. Increased feed productivity in livestock spills over into crop sectors through increased demand for feed crops and lower land prices, which stimulate demand for land, resulting in a modest overall decline in agricultural land use (S1). Stimulating livestock production results in a small increase in total agricultural GHG emissions (S6).

Less demand for labour in livestock is not fully compensated by increased demand in crop production, resulting in a small decrease in agricultural wages. This wage decrease is outpaced by decreasing food prices (E6), so the affordability of cereals (I1) and healthy diets (I2) improves. Lower food prices create room for non-food expenditures, pushing up non-agricultural wages in addition to the small decrease in agricultural wages.

The stimulus of livestock and aquaculture production increases the consumption of animal-sourced foods in all economies by lowering their price, reflected by the small increase in perishable products (N7), while fruit and vegetable consumption remains stable (N2). Increased consumption of fish from aquaculture raises poultry and fish consumption relative to red meat (N4). While the affordability of cereals (I1) and a healthy diet (I2) improves for the lowest-paid workers, the stimulus of livestock and aquaculture through feed productivity has a limited impact on average nutrition patterns.

FIGURE A1.3 DOUBLING THE PRODUCTIVITY OF FEED FOR LIVESTOCK AND AQUACULTURE



Source: Kuiper and Verma, 2021.

The total changes in the economy are also limited, apart from lower food prices (E6) and a slowing of rural transformation (E2). Reduced pressure on land reduces agricultural value added with less land use (S1) at lower prices, while agricultural employment contracts only very slightly (E3), thus lowering the value added per worker used to define rural transformation.

Simulation 3 Halving yield gaps in cereals and fruits and vegetables

Positive for inclusiveness and nutrition, but agricultural emissions increase

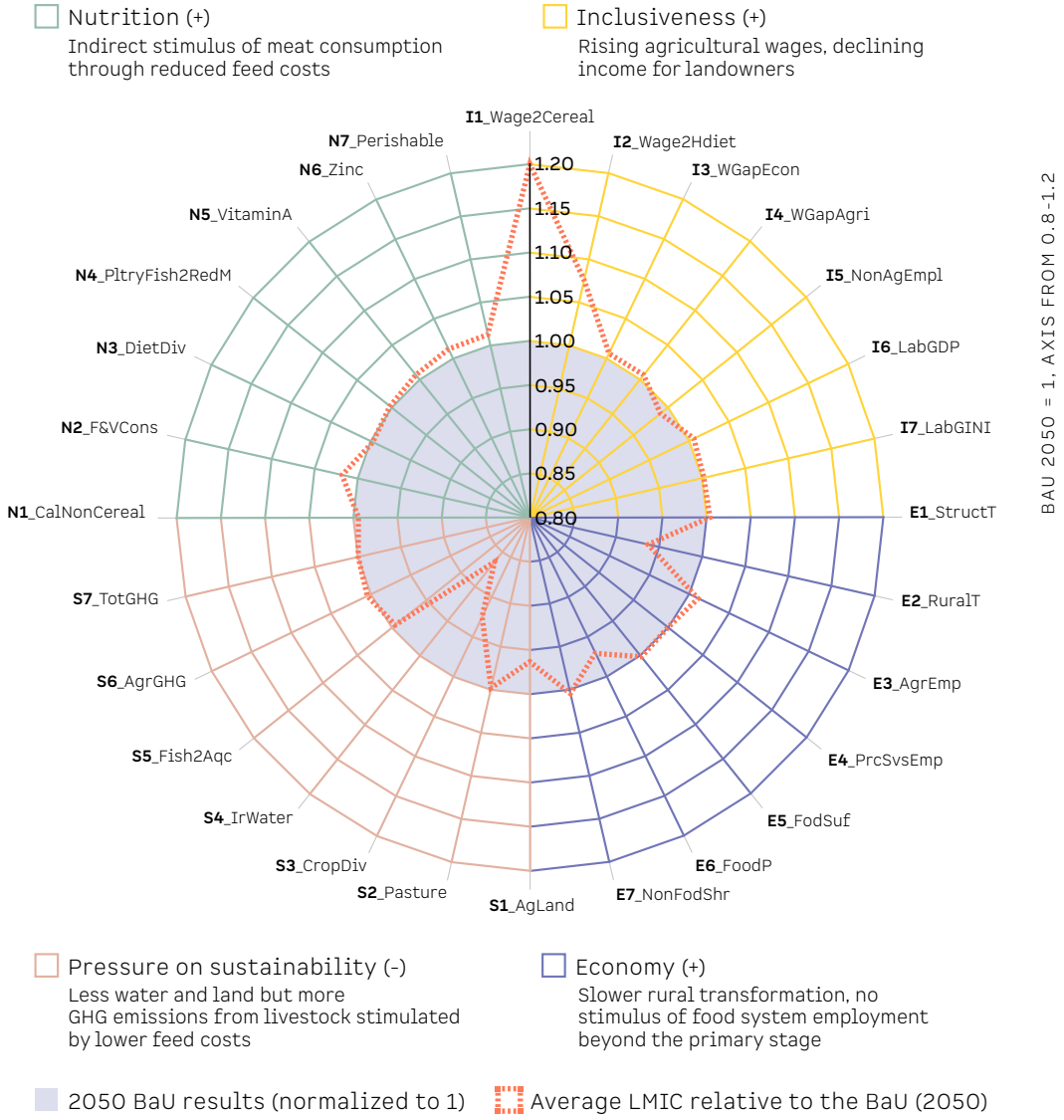
The effects of closing yield gaps were explored in a MAGNET scenario simulating the effects of halving the yield gaps for cereals and fruits and vegetables – essentially, doubling the current productivity of land with no increase in inputs (or other costs). The results show how closing yield gaps changes the trajectory of food system transformations in 2050, compared with the baseline BaU scenario for all low- and middle-income economies (**FIGURE A1.4**).

Overall, the simulation shows that the effects of the induced shock on inclusiveness are positive, as are nutritional impacts. The productivity increase lowers food prices (E6) compared with the simulated prices of 2050 under a BaU scenario (represented by the grey circle). Lower food prices and higher low-skilled agricultural wages boost the affordability of both cereals (I1) and a healthy diet (I2). These higher wages also pull low-skilled workers out of non-agricultural employment (I5).

Lower food prices create more room for non-food expenditure shares (E7), benefiting consumers. Lower food prices reduce the income of agricultural producers through lower land payments and contractions in land areas (S1). Combined with more agricultural workers (I5), this slows the rural transformation (E2), defined as agricultural factor payments over number of workers. For the lower-income economies, increased agricultural productivity further stimulates structural transformation (E1), with the value-added shares of industries and services in GDP increasing. While primary inputs for processing and services sectors become cheaper, this does not translate to an increase in employment (E4).

Increased productivity of cereals and horticulture lowers demand for irrigation water (S4). It also reduces the amount of agricultural land (S1), since the same production levels can be attained with less land, freeing non-land inputs for use elsewhere. Increased cereal productivity also allows a strong move away from costly land, resulting in the largest agricultural land contraction and a small increase in total pasture area (S2). Limited space for pastures drives an increase in the share of land used for oil seeds, which can be used for feed (directly or through the oilcake by-product from vegetable oil production). The increased productivity of cereals and fruits and vegetables is thus used in part to increase livestock production, increasing agricultural GHG emissions (S6).

FIGURE A1.4 HALVING YIELD GAPS IN CEREALS AND FRUITS AND VEGETABLES



Source: Kuiper and Verma, 2021.

Simulation 4 Halving farm gate food losses

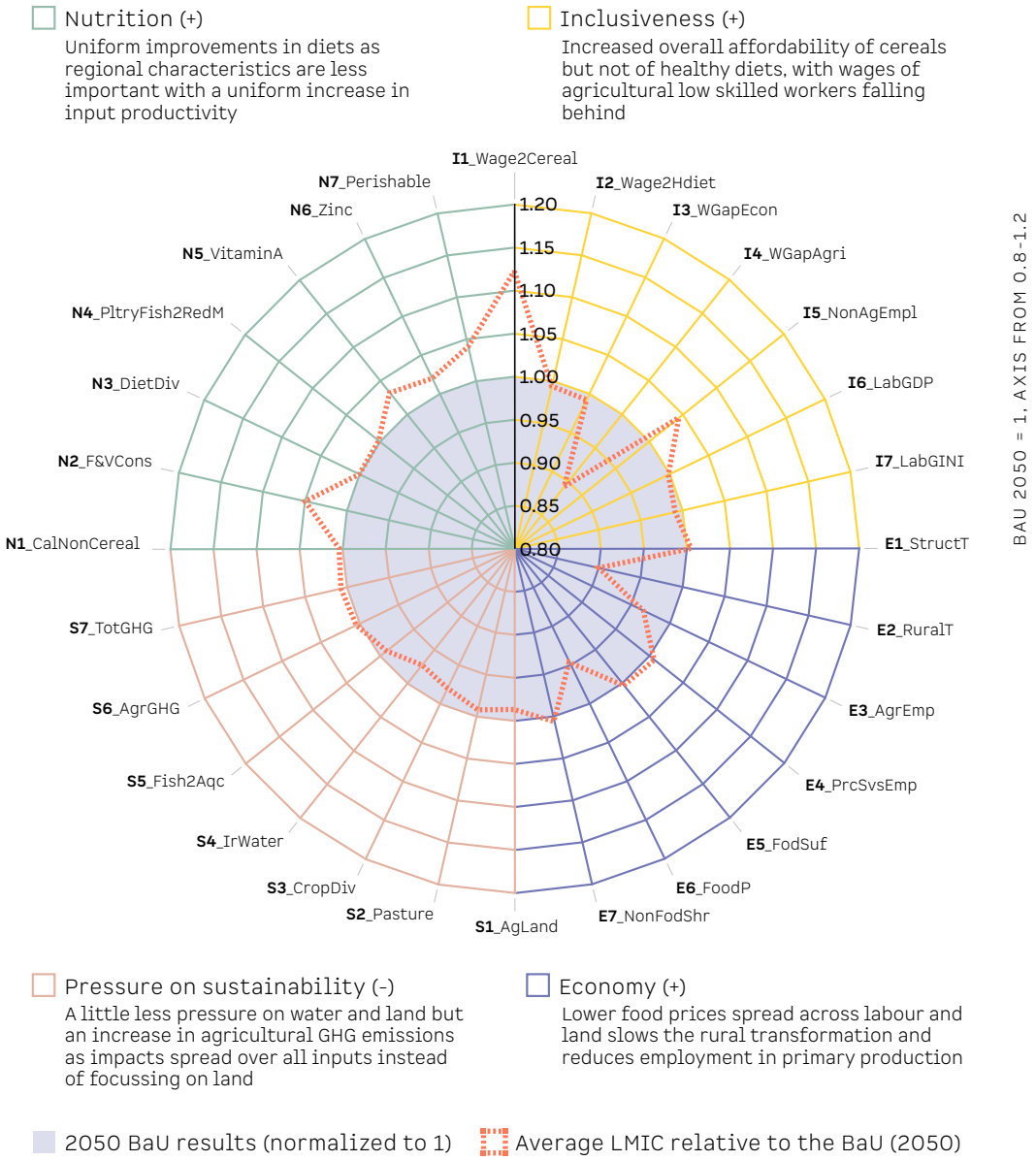
Reducing farm gate losses has mixed prospects for inclusiveness, improves nutrition and has modest effects on sustainability

This simulation halves global food loss rates for cereals and fruits and vegetables and is derived from Stathers et al. (2020). Because reduced losses imply that more usable output is obtained from the same inputs, MAGNET simulates a farm gate output productivity increase at 50 per cent of the loss percentage. The same sectors are targeted as in the yield gap scenario, but productivity is not tied to the use of land. This strongly affects the food system impacts, showing the importance of intervention design.

With closing yield gaps (CHAPTER 3), the productivity increases were tied to land. This limited the benefits for economies with little land, reducing the average impact on nutrition. With less food lost, the availability of output increases irrespective of inputs used, reflected by a positive change in nutrition indicators over all economies. Despite a lower increase in productivity for fruits and vegetables (17 per cent) than in the simulation closing yield gaps (16-112 per cent) in chapter 3, there is a stronger increase in household fruit and vegetable consumption (N2). This indicates that diets benefit more directly from food loss reductions raising the productivity of all inputs, than from closing yield gaps and tying the productivity increase to the use of land.

As with closing yield gaps, food prices (E6) go down as cereal and fruit and vegetable productivity increases, but the impacts on affordability are now tempered by lower wages for low-skilled agricultural workers. Lower food prices create more space for non-food expenditures at the national level, as lower food prices stimulate food demand only for the poorest households unable to afford the desired amount of food. The increased demand for non-food production pulls low-skilled workers into non-agricultural employment (I5) through higher non-agricultural wages. At the same time, the output productivity pushes labour (most of low-skilled) out of agriculture (E3) as fewer inputs (including labour) are needed to produce the same amount of output. This lowers the agricultural wages of the low-skilled, further widening the wage gap between them and those employed in non-agriculture (I4), and also widening the wage gap between them and other workers (I3). The net result is an improvement in the affordability of cereals (I1) and a small decrease in the affordability of a healthy diet (I2). While the drop in low-skilled agricultural wages on average outpaces the drop in cost of a healthy diet, this hides variation across economies. In the poorer fast-growing economies, the affordability of a healthy diet improves against BaU, thus improving the opportunities for making healthier diet choices.

FIGURE A1.5 HALVING FARM GATE FOOD LOSSES FOR CEREALS AND FRUITS AND VEGETABLES



Source: Kuiper and Verma, 2021.

The reduced demand for inputs to achieve the same amount of output is reflected in less pressure on natural resources. Overall changes are similar to closing yield gaps in reducing pressure on water (S4) and land (S1, S2). But a minimal increase in agricultural GHG emissions (S6) linked to spillovers into cheaper feed production stimulates livestock production, while a stimulus of non-food production raises total GHG emissions (S7).

Simulation 5 Increasing import tariffs to promote food self-sufficiency

Import tariffs reduce nutrition security among the poorest people in low- and middle-income countries, at the expense of sustainability

COVID-19 rekindled interest in reducing reliance on global trade networks by reducing food imports. This simulation promotes food self-sufficiency in low- and middle-income countries by a generic doubling of imported food prices, either for direct consumption or as intermediate inputs for further processing by domestic industries. There are no additional tariffs on agricultural inputs (seed, fertilizers and feed).

Despite the intended profound implications for food trade – imports of food items and raw materials for the agro-industry are roughly halved – there are substantial trade-offs in other areas. Not taxing agricultural inputs creates opportunities for agricultural intensification. These opportunities, alongside increased pressure on domestic production in food-importing economies, support rural transformation (E2), at the cost of delaying structural transformation (E1), by pulling resources back into primary production.

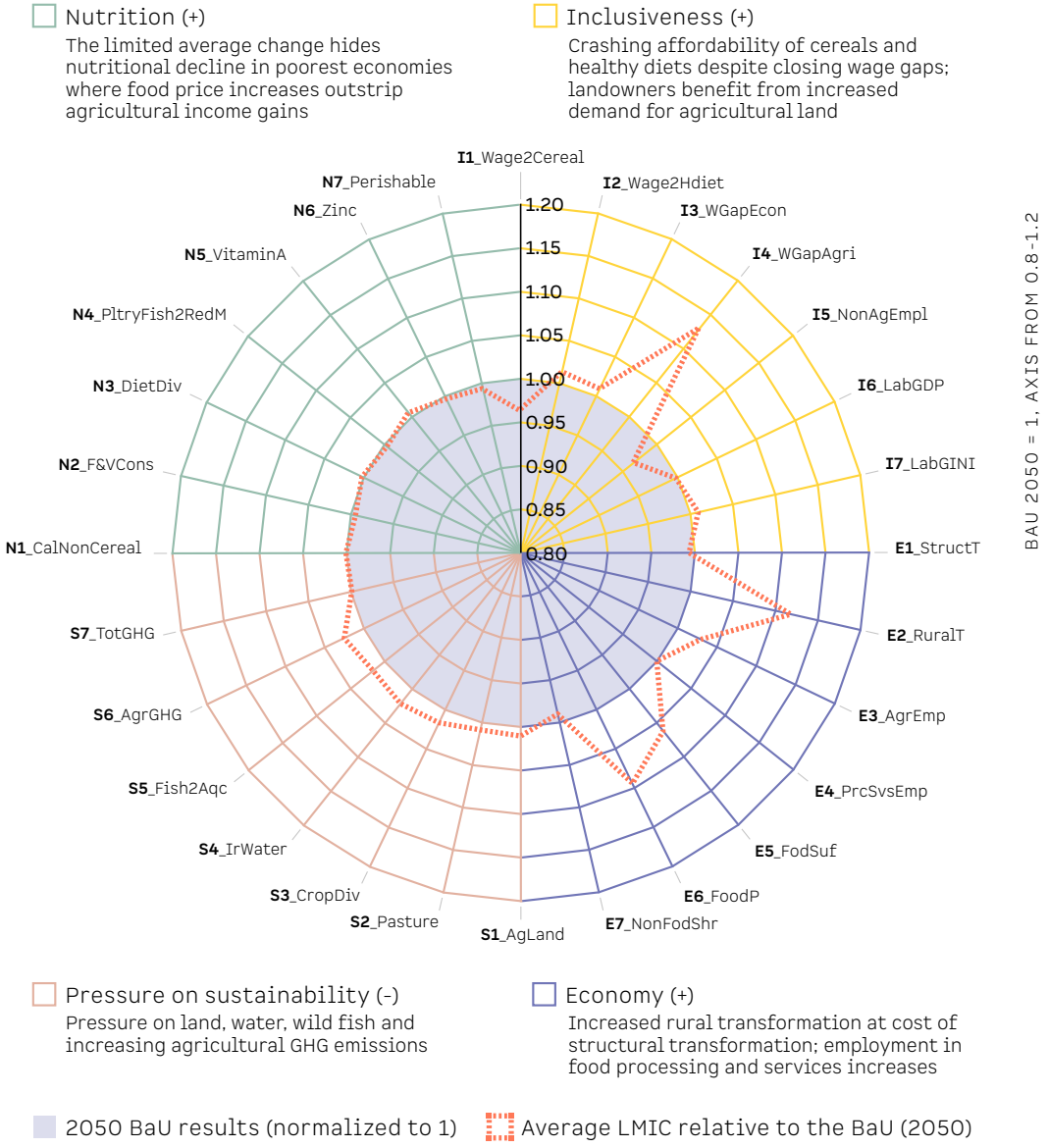
Trade protection increases pressure on domestic production in food-importing economies, where food prices rise, while in prices in food-exporting economies may drop. Averaging over all low- and middle-income countries, food prices increase (E6), making cereal-based diets less affordable for the lowest-paid (I1). In countries with limited land resources, land rental prices increase most, and landowners benefit from increased demand for agricultural land. In countries better endowed with land and labour, the loss of export markets leads to a reduction in rural employment and a decline in agricultural wages. On average over all low- and middle-income countries, however, agricultural low-skilled wages increase, reducing the gaps between them and both non-agricultural low-skilled wages (I4) and more skilled workers (I3). Apart from the pull of higher agricultural wages, low-skilled workers are also pushed out of non-agricultural employment (I5) because less income is available for non-food purchases (E7).

With average private household income roughly stable, economy-specific changes in food prices generate a varying pattern in nutrition indicators not visible on average for the low- and middle-income countries, apart from the drop in affordability of cereals for the poorest (I1), signalling a substantial decline in nutritional status of the poorest.

In addition, pressure on domestic natural resources increases (on land, water, wild fish), even while feed and fertilizer imports are allowed, and somewhat relieve land constraints. The contraction of international trade reduces fossil fuel emissions associated with transport, while the declining demand for non-food expenditure also reduces fossil fuel emissions. But

increased land use and intensified production of crops (fertilizer) and livestock (feed) increase agricultural GHG emissions (S6) so that in all economies total emissions increase slightly (S7).

FIGURE A1.6 INCREASING IMPORT TARIFFS TO PROMOTE FOOD SELF-SUFFICIENCY



Source: Kuiper and Verma, 2021.

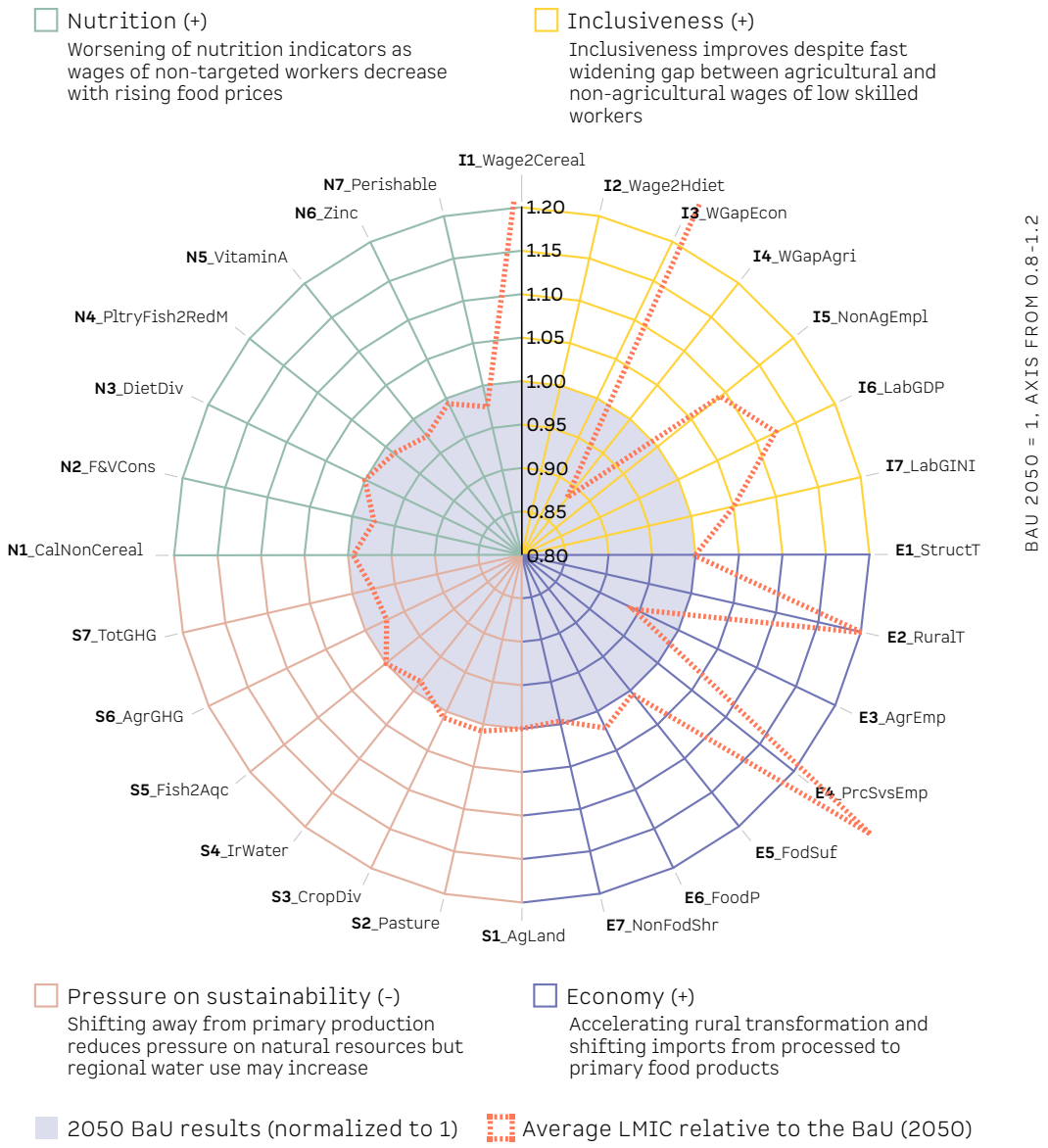
Simulation 6 Increasing midstream employment by subsidizing low-skilled labour

Increasing low-skilled labour in midstream activities improves inclusiveness but has mixed impacts on nutrition and sustainability

A major increase in midstream employment might interact with other food system features and create unforeseen trade-offs with inclusivity, nutrition, economic or environmental outcomes. The midstream employment scenario subsidizes the low-skilled labour in food processing, wholesale and transport at a rate equal to half the projected low-skilled wage increase under the (BaU) scenario. The strong pull of labour into processing (E4) makes low-skilled labour more scarce. This promotes rural transformation (E2) by boosting wages and reducing the number of agricultural workers (E3). It also raises food prices (E6), reducing the expenditures on non-food products (E7).

The simulation indicates a generally positive correlation with indicators of inclusivity. The increased demand for low-skilled labour increases their wage, reducing the wage gap between these workers and other types of workers (I3). The combination of higher wages for the poorest and high numbers of employment in better paying non-primary sectors translates into substantial improvements in the labour-based GINI (I7) and an increasing labour share in GDP (I6). The boost to agricultural wages by far outpaces food price increases, improving the affordability of cereals (I1) and healthy diets (I2) despite the higher food prices (E6). Stimulating non-agricultural low-skilled jobs, however, also substantially widens the gap between agricultural and non-agricultural low-skilled workers (I4). Although all low-skilled workers benefit from the increased demand for them, those able to secure a job in the midstream sectors will benefit more than those remaining in agriculture.

FIGURE A1.7 INCREASING MIDSTREAM EMPLOYMENT BY SUBSIDIZING LOW-SKILLED LABOUR



Source: Kuiper and Verma, 2021.

The simulation points to a possible trade-off with nutrition. Higher wages in agricultural production – as workers leave the sector for midstream employment, pushing agricultural wages up – lead to higher food prices, particularly for labour-intensive crops such as fruits and vegetables. Wages of higher-skilled workers (not targeted by the subsidy) fall as they are pushed out of midstream sectors. On average, this reduces income and negatively affects nutrition, though the impacts vary strongly across economies depending on the composition of the labour force.

On potential trade-offs with environmental factors, the overall effect of a shift out of primary production to midstream activities reduces pressure on natural resources in low- and middle-income countries, notably total GHG emissions (linked to less demand for non-food products) and agricultural GHG emissions from less domestic primary production. This is in part a shift of natural resource use to high-income economies not subject to the low- or middle-income country midstream employment stimulus, from which primary imports are sourced as domestic production becomes increasingly expensive.

Simulation 7 Halving the growth of processed food consumption

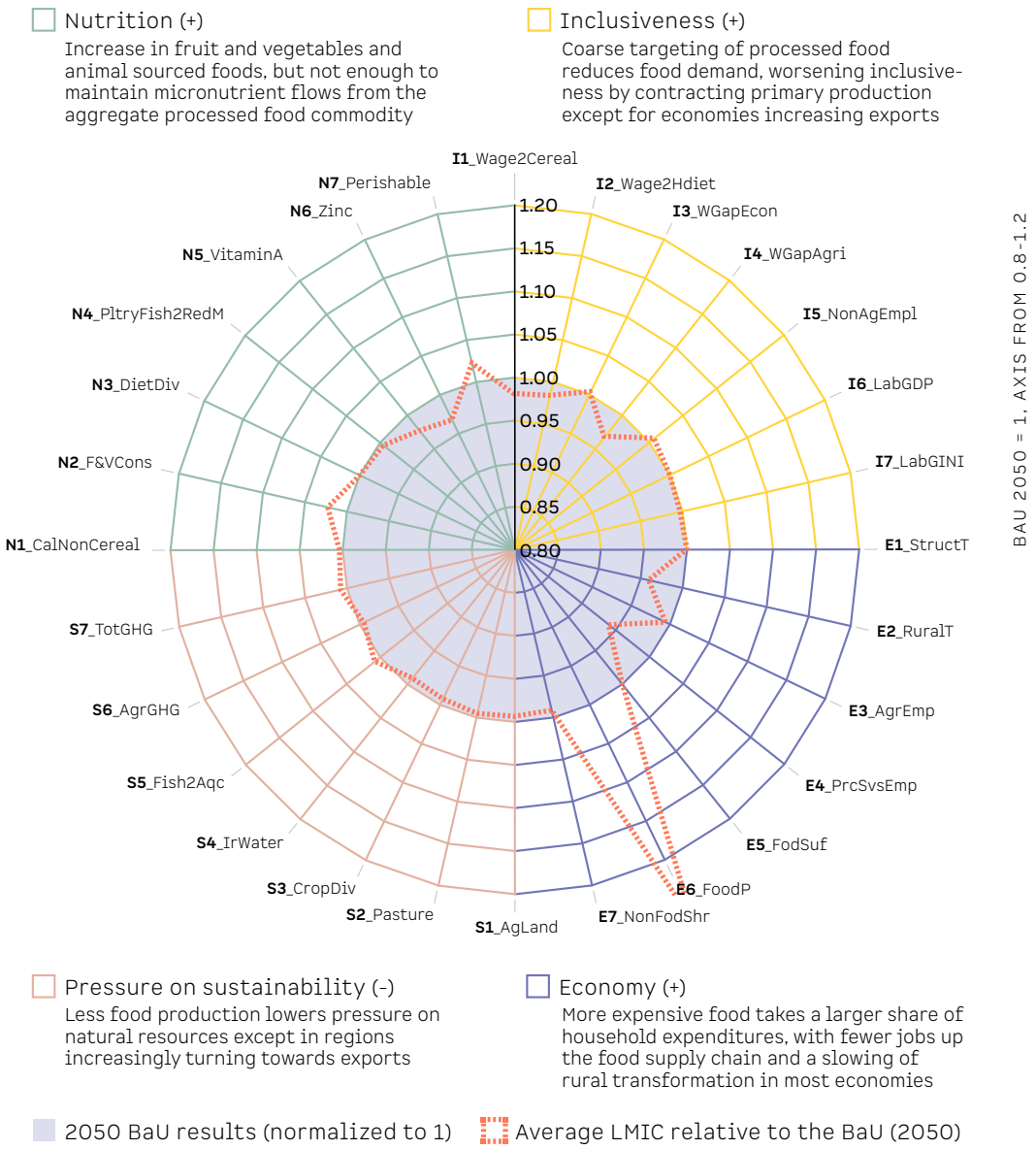
Coarse targeting of processed food consumption reduces food demand and worsens inclusiveness by contracting primary production

Increasing consumption of ultra-processed food is a concern, but beyond the reach of the MAGNET product detail. As part of a broader shift towards processed foods with rising incomes, the processed food scenario halves BaU growth rates of processed food consumption (a large but not further differentiated product in MAGNET). The simulation targets both direct purchases of processed food and food services (a main channel for processed food consumption) through a tax on household consumption.

The worsening of several nutrition indicators – ratio of poultry and fish to red meat (N4, vitamin A (N5), zinc (N6) – shows the importance of well-targeted interventions in processed food consumption because many processed foods make a positive contribution to diets. Taxing processed food consumption shifts consumption to meat and fish, sugar, and fruits and vegetables. These shifts are not enough to compensate for lost micronutrient deliveries through the blunt targeting of processed food, and they signal that the consumption taxes reduce overall food consumption by strongly increasing food prices for households (E6).

In low- and middle-income countries, the average changes in non-food shares of household expenditures (E7) are very moderate. They hide strong reductions in poorer economies, where food forms a large share of household expenditures and has much stronger BaU growth requiring higher taxes. Employment in processing and food services (E4) is reduced by the halving of demand for processed food and food services.

FIGURE A1.8 HALVING THE GROWTH OF PROCESSED FOOD AND FOOD SERVICE CONSUMPTION



Source: Kuiper and Verma, 2021.

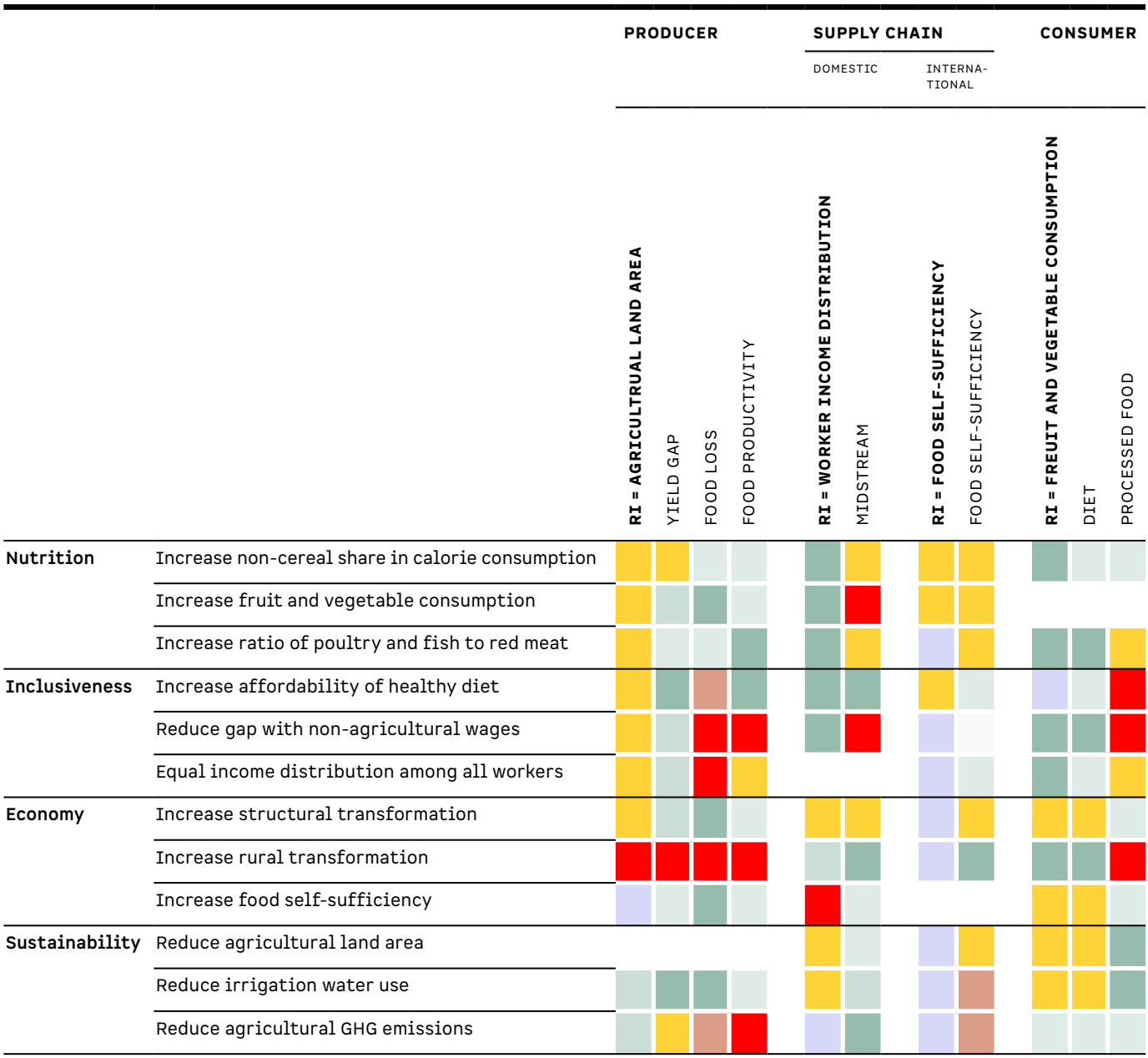
While the taxes increase the household cost of processed food and food services, they lower the market price as demand and thus production of these commodities contracts. The consumption of non-taxed food increases only moderately through an interplay of three factors: remaining processed food and food service consumption is much more costly, leaving less budget for other food. An overall reduction in demand for primary production lowers both agricultural wages and returns to land, affecting incomes of the poorest households. Increased demand for primary and non-taxed processed foods increases their market price.

Less affordability of cereals (I1) and a healthy diet (I2) result from higher consumer food prices and lower agricultural wages. Low-skilled agricultural workers are affected more than others – as signalled by the widening wage gap between them and other workers (I3) and low-skilled workers in non-agriculture (I4), pushing them out of agriculture (I5). The only economies escaping this worsening inclusiveness are those building on agricultural endowments to increase exports. This allows an increase in agricultural wages, which maintains the affordability of cereals and healthy diets despite closing wage gaps.

Summarizing MAGNET simulation results across food system components

Although the simulations have not been designed to highlight how intervention design affects outcomes, we can compare results by simulation to the overall assessment of synergies and trade-offs to gain some insight into the importance of intervention design. To this end, we group the simulations by primary producer, supply chain and consumer. We then select a reference indicator best matching shared objectives for each group of simulations to establish common ground for a comparison across simulations. Converting simulation indicator scores for all low- and middle-income economies to correlations to the reference indicator can highlight how choices in intervention design result in different synergies and trade-offs (**TABLE A1.1**).

FIGURE A1.9 SYNERGIES AND TRADE-OFFS: EFFECTS OF DIFFERENT TYPES OF POLICIES ON FOOD SYSTEM OUTCOMES



Note: Three key indicators were selected in each food system domain (outlined in CHAPTER 1) closely linked to objectives of food system policies (N1, N,2, N4 for nutrition; I2, I4, I7 for inclusiveness, E1, E2, E5 for economy, S1, S4, S6 for sustainability).
Source: MAGNET simulations.

Reducing land area by increasing productivity of primary producers. Three simulations implement different types of productivity increases at the primary production stage: reduction of yield gaps and food loss and improvement in feed productivity. They share a common impact of reducing the agricultural land area. This creates synergies with most sustainability objectives but trade-offs with inclusiveness and economic growth objectives. The productivity increases result in overall synergies with nutrition. Reducing the yield gap stimulates the use of (hired) labour and lowers food prices, but also delays outflows from agriculture and stimulates the demand for non-food commodities, while improving the comparative trade advantage relative to high-income countries.

Income distribution and import dependency with supply chain interventions. Two distinct interventions in the supply chain are simulated: promoting midstream employment and reducing food import dependency. Pulling substantial numbers of workers out of primary production into midstream employment increases the primary production costs. Higher wages for agricultural labourers allow an improvement in healthy diet affordability alongside an improved GINI, but increase the wage gap. As food prices increase and only part of the workers experience increased wages a trade-off with nutrition objectives appears. Moreover, the contraction in primary production generates synergies with sustainability objectives. But increasing food self-sufficiency by raising import tariffs mainly leads to trade-offs with nutrition due to less affordability of healthy diets. The import barriers for primary and processed foods stimulate domestic food production but generate trade-offs with sustainability as more land is needed to replace the imports from more efficient economies.

Fruit and vegetable consumption in consumer-focused simulations. Two simulations alter the food system by changing household consumption decisions: imposing a flexitarian diet and halving the consumption of processed food. Overall increased fruit and vegetable consumption is associated with synergies in nutrition and inclusiveness, but trade-offs on economy and sustainability. The diet simulation improves agricultural wages and the affordability of healthy diets, while reducing GHG emissions. Although very appealing, simulation may overestimate gains as it relies on a preference shift that is costless. In contrast, the processed food simulation relies on taxes, using the observed responsiveness of consumers to price incentives. Increasing the cost of food leads to a contraction in primary production and lower wages of agricultural workers, while stimulating non-agricultural sectors whose products are not taxed. The contraction of primary production generates environmental synergies by reducing land and water use and lowering agricultural GHG emissions.

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ANNEX 2
Data and methodology

1 Introduction

This data annex accompanies the *Rural Development Report 2021: Food Systems for Rural Prosperity*. It aims to document data sources and methods of estimation for the data and visualizations used in the Report and highlights messages for each of the following areas:

- Poverty
- Food security and nutrition
- Gender
- Agrifood economy and employment
- Rural households economic diversification
- Digital
- Social protection
- Small-scale agriculture
- Ease of doing business and enabling the business of agriculture

Throughout the annex we disaggregate the data by geographic region and by income level – as defined by the World Bank. Whenever possible, we also show rural/urban disaggregation.

We use the following icons for ease of presentation:

	Sources, references, links to data
	Highlight messages
	Caveats and considerations

KEY MESSAGES

Poverty

- Seven out of 10 people who live in extreme poverty live in rural areas.
- 1.5 billion people who are moderately poor live in rural areas.

Food security and nutrition

- An increasing number of countries are suffering from a double burden of malnutrition: hunger and child undernutrition with adult overweight and obesity.
- As countries increase their income levels, they decrease child undernutrition and increase adult overweight and obesity.
- Middle-income countries suffer more than others from a double burden of malnutrition.
- Throughout the world, pulses and fruits and vegetables are available at a much lower level than that required for a healthy diet.
- In low-income countries, the availability of cereals roots, tubers and plantains is almost three times what is needed for a healthy and sustainable diet. In contrast, the availability of fruits and vegetables is two and a half times less than the recommended intake.
- In high-income countries, the availability of sugars and fats is almost double the recommended intake. The availability of pulses, seeds and nuts, on the other hand, is one fifth that required for a healthy diet.

Gender

- Structural inequalities make plots managed by women significantly less productive than those managed by men.
- In low-income countries, women can earn as little as 15 cents for each dollar earned by men working in the agricultural sector.

Agrifood economy and employment

- The lower the income level, the larger the proportion of employment in agricultural activities and the larger the share of employment in food systems. Non-farm employment (manufacturing plus food and beverage service activities) does not seem to vary with different levels of income.
- In every region, the labour force in the hinterlands dedicates between 70 per cent and 87 per cent of its time to farming and agrifood-related activities.
- In low- and middle-income countries, food systems provide important employment opportunities beyond the farm gate.

Rural households' economic diversification

- Own-farm activities are an important source of income for most rural households in our sample of low- and middle-income countries.
- The greater part of the income of small-scale farms in sub-Sahara Africa comes come farm and agriculture labour, whereas in Latin America, small-scale farms derive most of their income from non-farm and non-agricultural activities.

Digital

- The rural-urban gap in mobile internet adoption is reducing but remains substantial. The reduction was driven by South Asia, where the gap fell from 47 per cent to 30 per cent between 2017 and 2019.
- Despite an overall reduction in the gender gap of mobile internet use in low- and middle-income countries from 27 per cent to 20 per cent, there are still more than 300 million fewer adult women than men using mobile internet.

Social protection

- Worldwide, less than half of the population is covered by at least one social protection benefit. This figure reduces to less than one fifth for Africa and less than two fifths for Asia and the Pacific.
- Low-income countries tend not to reach the median coverage (of at least one social protection benefit) of upper-middle-income countries.

KEY MESSAGES (CONT.)

Small-scale agriculture

- Very small holdings (<1 ha) constitute the majority of farms in all income groups. Still, they account for less than one fourth of the land in low-income countries and around 1 per cent in upper-middle-income countries.
- Very small holdings (<1 ha) constitute the majority of farms yet they hold 7 per cent of the land and produce over one tenth of the food. Large holdings (>20 ha), on the other hand, constitute 6 per cent of the total holdings, yet they account for 80 per cent of the land area and produce almost half (47 per cent) of the total food.

Ease of doing business and enabling the business of agriculture

- Low-income countries face far more challenges when doing business, including in the agricultural sector.

2 Country characterization

IFAD's *Rural Development Report 2019* used macro data from 85 countries to analyse structural and rural transformation processes and derive a country transformation typology. The data were from circa 2016. The sample included all low- and middle-income countries, except island nations, resource-dependent nations and countries for which there was no available information. The typology used two variables to define the level (low or high) of structural and rural transformation for each country, as follows:

- For structural transformation (ST):
  - Variable: non-agricultural value added (as a percentage of GDP)
  - Measure: relative value to the sample average (80 per cent)
- For rural transformation (RT):
  - Variable: agricultural value added per worker (constant 2010 US$)
  - Measure: relative value to the sample median (US$1,592)

We initially used these measures to categorize countries into four different types of economies:

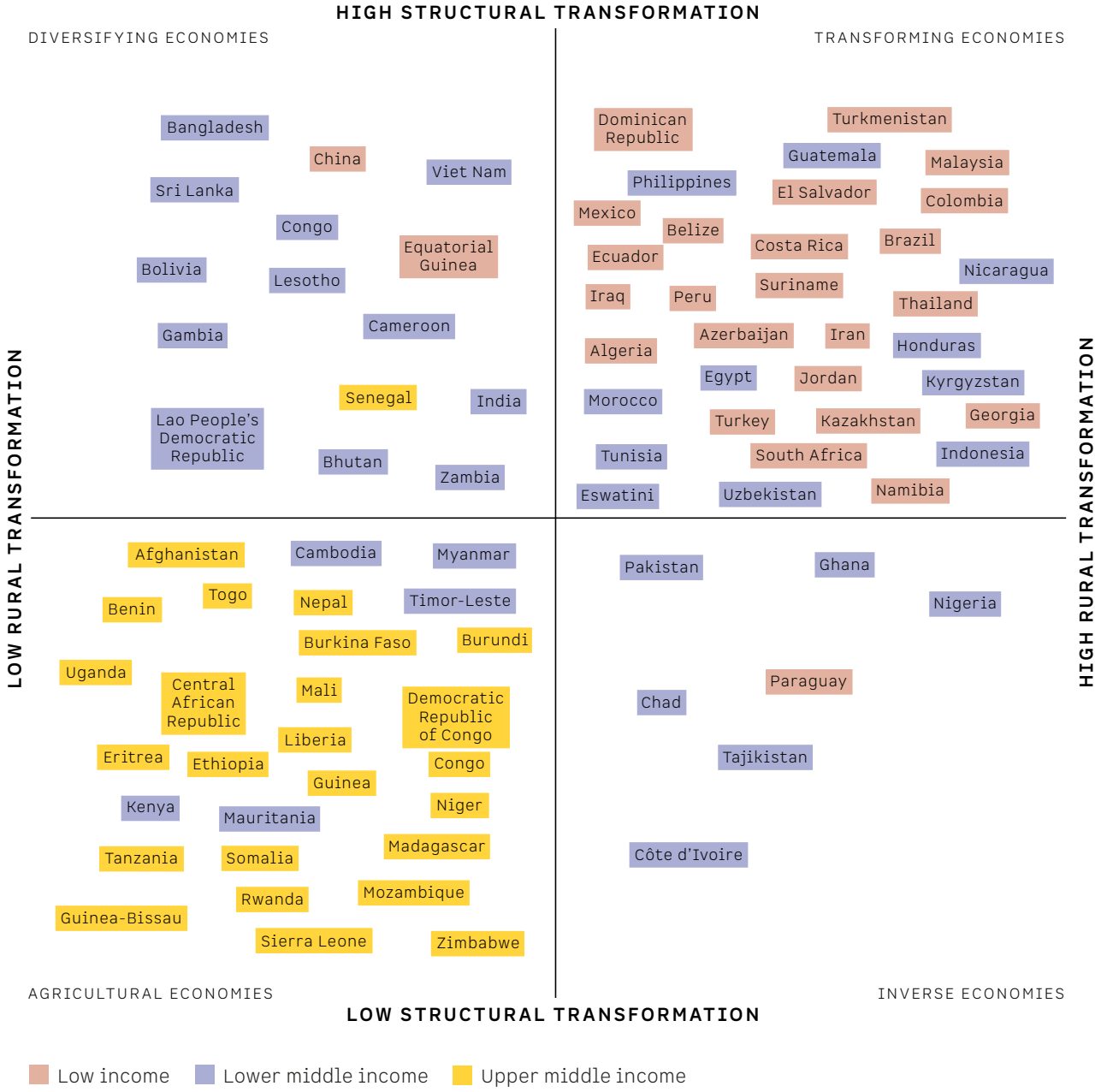
- Transformed economies: countries with high ST and high RT
- Diversifying economies: countries with high ST and low RT
- Inverse economies: countries with low ST and high RT
- Agricultural economies: countries with low ST and low RT

FIGURE A2.1 shows the categorization of countries using the *Rural Development Report 2019* data.

FIGURE A2.1 shows a high correlation between levels of transformation – especially at the extremes – where transformed economies (high-high) are primarily those of upper-middle- and lower-middle-income countries, and agricultural economies (low-low) are mostly those of low-income countries.

However, recent global changes have meant a transition of big economies such as China and India to the transforming economies group and some other smaller ones moving out of the inverse economies group, making it almost inexistent. Using up-to-date data for the typology measures also shows no clear correlation between the country categorization and relevant variables such as agricultural value added, level of agricultural employment or even poverty rates.

FIGURE A2.1 COUNTRY CATEGORIZATION AND LEVEL OF INCOME

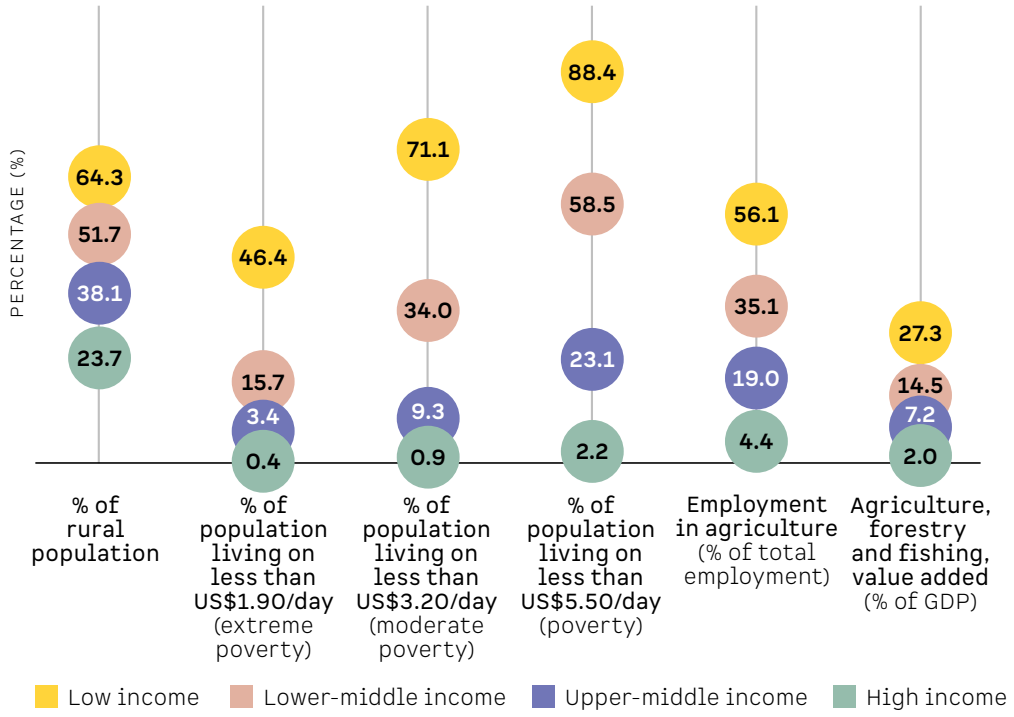


Note: The position of the countries does not reflect the actual distances from the relevant variables mean and median.

A country's level of income, however, seemed to be correlated with the different aspects examined in the report. Therefore, we use income level groups – as defined by the World Bank: high, upper-middle, lower-middle and low – to disaggregate the information. **FIGURE A2.2** shows key characteristics of the income groups.

There are further substantial differences across and within these income groups in terms of the nature of their food systems, levels of malnutrition, differential access to technology by geography and gender, among others. We explore these in detail in the following sections.

FIGURE A2.2 FOOD SYSTEMS VARY SUBSTANTIALLY BY COUNTRY INCOME, SHAPING THE OPPORTUNITIES AND CONSTRAINTS FOR DIVERSIFIED RURAL LIVELIHOODS



Note: Covers 152 countries with 7.3 billion people.
Source: World Bank 2020b and Povcal (http://iresearch.worldbank.org/PovcalNet/povDuplicateWB.aspx).

3 Poverty

In this section we portray the level of urban and rural poverty using different international poverty lines. We focus on extreme and moderate poverty and show the proportions of people living in poverty disaggregated by region and by income level. Information comes from different sources:

	For extreme poverty disaggregated by rural and urban – World Data Lab – World Poverty Clock https://worldpoverty.io/ (data accessed upon request)
	For poverty headcounts at the international poverty lines of US$3.20 and US$5.50 per day – World Bank – PovCal http://iresearch.worldbank.org/PovcalNet/povDuplicateWB.aspx
	For moderate poverty disaggregated by rural and urban locations – FAO (2017), The State of Food and Agriculture. Leveraging Food Systems for Inclusive Rural Transformation, Statistical Annex https://reliefweb.int/sites/reliefweb.int/files/resources/a-I7658e_0.pdf

We use the following definitions of poverty:

Extreme poverty – The current international extreme poverty line is set at US$1.90 a day in 2011 PPP (purchasing power parity) terms, which represents the mean of 15 national poverty lines for the poorest countries. These are the same 15 countries that defined the poverty line of US$1.25 a day in 2005 PPP terms.

Moderate poverty – Moderate poverty is defined as the population living below the international poverty line of US$3.20 a day in 2011 PPP terms. The US$3.20 line is typical of low- and middle-income countries. This poverty line is an update from the previous one set at US$3.10 a day based on new information on costs of living. In this annex, we use both these lines because the current estimates of moderate poverty have not been disaggregated by rural and urban locations.

Poverty – This is broadly defined as the population living below the international poverty line of US$5.50 a day in 2011 PPP terms. This line is typical of upper-middle-income countries.

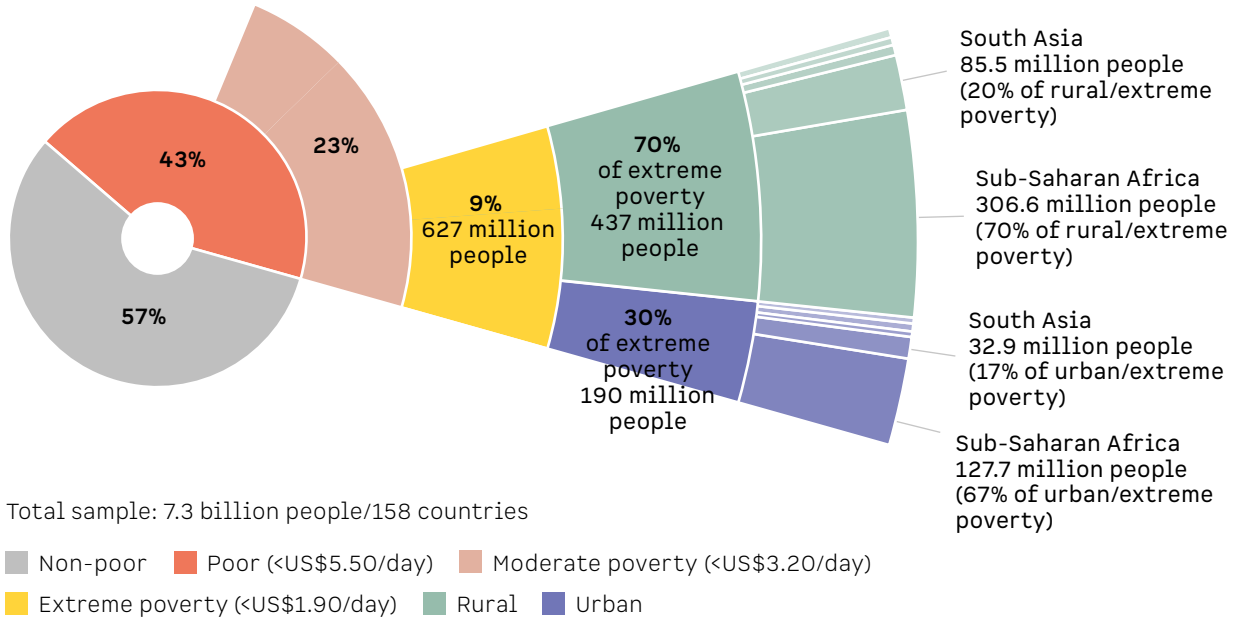
Extreme poverty in rural and urban areas by geographic regions

We have complete data on poverty estimates at the different international poverty lines, including for extreme poverty disaggregated by urban and rural locations, for 158 countries, with a total population of 7.3 billion people (about 96 per cent of the global population) in 2018.

TABLE A2.1 EXTREME POVERTY ESTIMATES COVERAGE BY REGION

	NUMBER OF COUNTRIES	TOTAL POPULATION
East Asia and the Pacific	20	2 282 269 984
Europe and Central Asia	48	904 785 417
Latin America and the Caribbean	23	556 070 437
Middle East and North Africa	14	377 659 243
North America	2	361 184 720
South Asia	7	1 772 312 556
Sub-Saharan Africa	44	1 059 470 860
Total	**158**	**7 313 753 217**

FIGURE A2.3 EXTREME POVERTY IS BECOMING CONCENTRATED IN RURAL AREAS, PARTICULARLY IN SUB-SAHARAN AFRICA



Source: Authors' elaboration using information from the World Poverty Clock and Povcal. http://iresearch.worldbank.org/Povca lNet/povDuplicateWB.aspx.

Based on this sample, 43 per cent of the global population are poor at the broadly defined poverty line, 23 per cent moderately poor and 9 per cent extremely poor.[1] Of the extremely poor group, 70 per cent live in rural areas and the other 30 per cent in urban areas. The extremely poor in rural areas are highly concentrated in the sub-Saharan region (70 per cent) and in South Asia (20 per cent).

Extreme poverty is largely concentrated in rural areas and in sub-Saharan Africa.

Seven out of 10 people living in extreme poverty reside in rural areas.

Moderate poverty

Moderate poverty estimates for urban and rural areas are not readily available from public official sources. They were commissioned from the World Bank for the IFAD *Rural Development Report 2016*. The figures were reproduced in the statistical annex of the FAO 2017 report, *Leveraging Food Systems for Inclusive Rural Transformation*.

Moderate poverty was defined then as the population living on less than US$3.10 per capita per day (see poverty definitions above). Using these data and complementing them with the upper-middle-income countries poverty line of US$5.50 left us with complete information for 90 countries, representing 5.8 billion people (or 76 per cent of the world's population), using 2018 population estimates.

TABLE A2.2 MODERATE POVERTY ESTIMATES COVERAGE BY REGION

	NUMBER OF COUNTRIES	TOTAL POPULATION
East Asia and the Pacific	10	1 998 570 545
Europe and Central Asia	6	126 450 021
Latin America and the Caribbean	19	553 223 890
Middle East and North Africa	7	305 239 499
South Asia	7	1 772 312 556
Sub-Saharan Africa	41	1 028 301 670
Total	**90**	**5 784 098 181**

[1] These figures are in line with those reported in the World Bank Poverty and Shared Prosperity Report (2020), which states: "About a quarter of the global population is living below the US$3.20 poverty line, and almost half is living below the US$5.50 line, compared with less than a 10th living below US$1.90." This means that adding urban/rural disaggregated figures and limiting our sample to the information available does not seem to have affected or biased our sample.

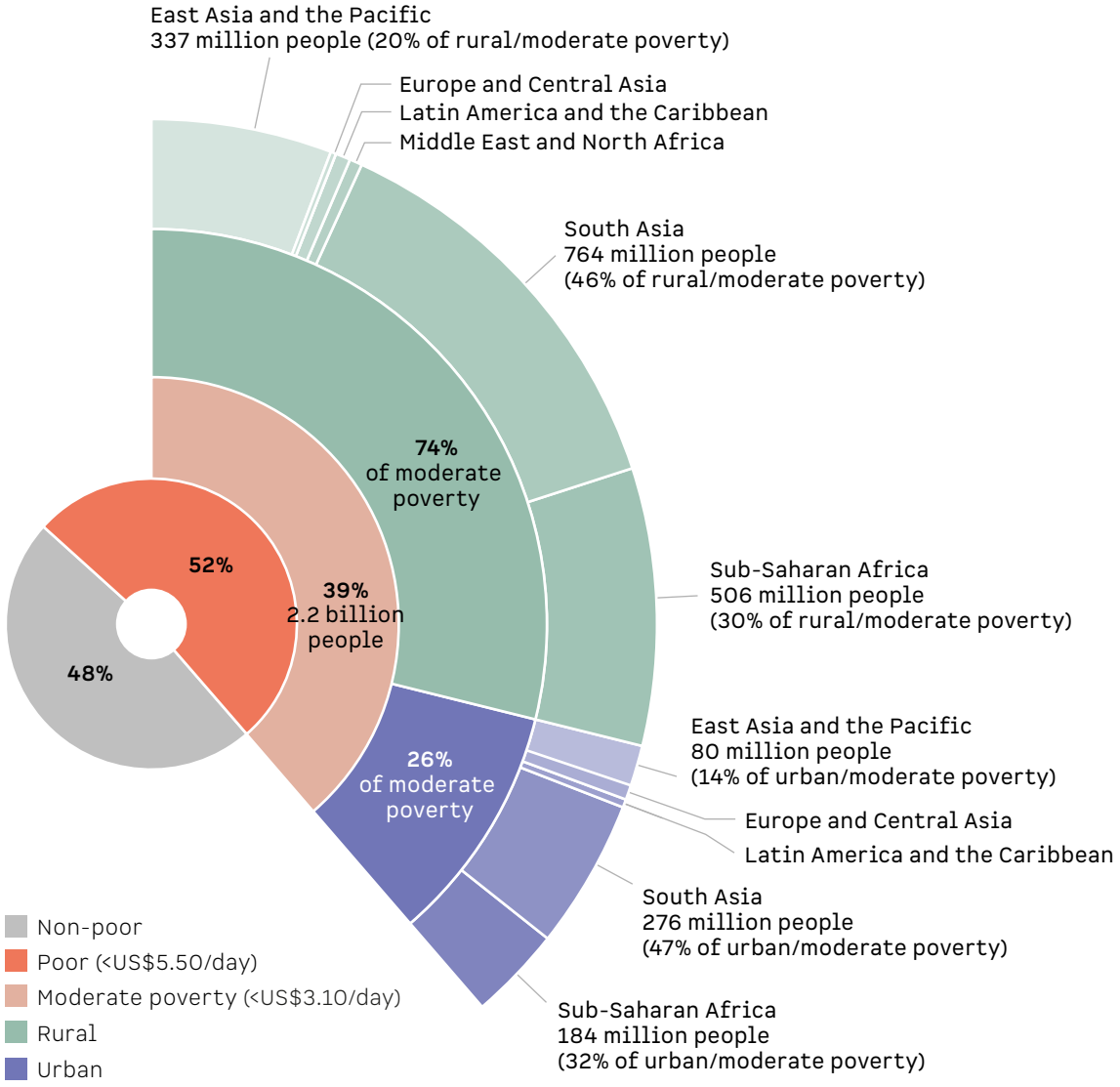
With this reduced sample, poverty at the US$5.50 a day line increases to 52 per cent. This is explained by the fact that the new sample (of 90 countries) excludes high-income countries. Moderate poverty, in turn, is 39 per cent. While this is again explained by the sample, the increase also has to do with the time of the surveys on which the figures are based: the surveys were conducted between 1992 to 2013, with 73 per cent carried out between 2009 and 2012. According to the World Bank, the global moderate headcount ratio in 2011, when most of the surveys were conducted, was 32.9 per cent. While we acknowledge that these figures are not directly comparable, it is a good reference point to deduce how great or small the bias in our sample is.

In this sample, 74 per cent of those living in moderate poverty live in rural areas and 26 per cent in urban areas. The former are concentrated largely in South Asia (46 per cent), sub-Saharan Africa (30 per cent) and East Asia and the Pacific (20 per cent).

Moderate poverty is largely concentrated in rural areas and in South Asia, sub-Saharan Africa and East Asia and the Pacific.

1.5 billion people who are moderately poor live in rural areas.

FIGURE A2.4 MODERATE RURAL POVERTY AND INEQUALITY REMAIN HIGH ACROSS EAST ASIA AND THE PACIFIC, SOUTH ASIA AND SUB-SAHARAN AFRICA, PREDOMINANTLY IN RURAL AREAS



Source: FAO (2017) for moderate poverty and Povcal http://iresearch.worldbank.org/PovcalNet/povDuplicateWB.aspx for poverty at $5.50 a day.

4 Food security and nutrition

A global double burden of malnutrition

Even though food security and nutrition have greatly improved in the 25 years between 1990 and 2015, the world is far from achieving zero hunger and undernutrition for children. At the same time, adult moderate and high overweight has become an accompanying concern. In this section we explore these issues using the food security and nutrition (FSN) typology developed by FAO and the International Food Policy Research Institute (IFPRI).

For FSN typology – FAO and IFPRI (2020) Progress towards ending hunger and malnutrition. A cross-country cluster analysis
https://doi.org/10.4060/ca8593en

For data and tables – IFPRI Progress towards ending hunger and malnutrition. A cross-country cluster snalysis., Food Security Portal
https://www.foodsecurityportal.org/node/62

According to FAO and IFPRI (2020), countries can be classified into six categories of food security and nutrition situations:[2]

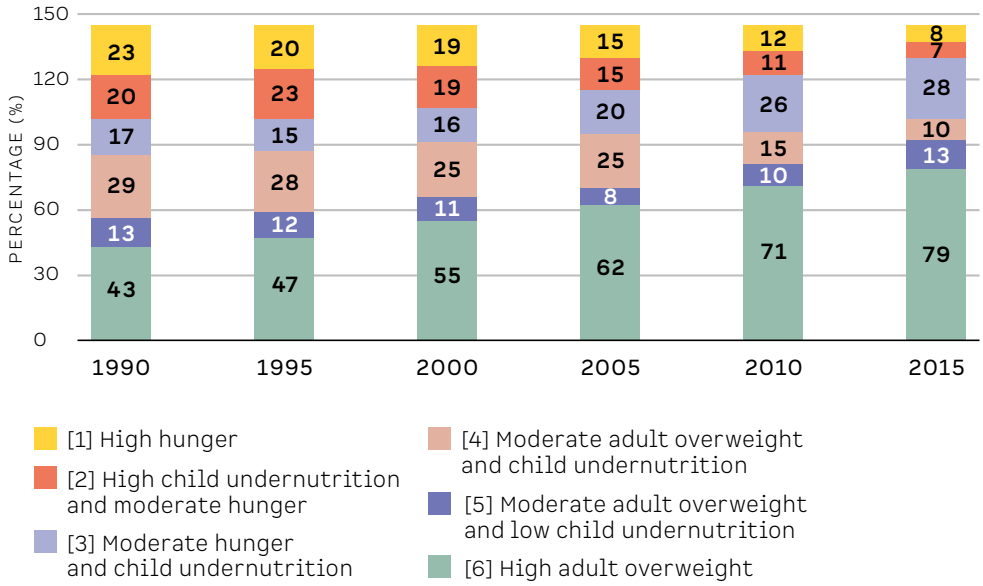
1. High hunger and high child undernutrition
2. Moderate hunger but high child undernutrition
3. Moderate hunger and moderate child undernutrition
4. Moderate child undernutrition and moderate adult overweight
5. Low child undernutrition and moderate adult overweight
6. No hunger, but high adult overweight

FIGURE A2.5 uses five-year intervals between 1990 and 2015 to show the change in the size of the six different FSN categories over this 25-year period. This analysis is based on a total of 145 countries.

While there are still a number of countries that have not yet solved the problem of hunger and child undernutrition, an increasing number are now facing the problem of high prevalence of adult overweight and obesity, resulting in a global double burden of malnutrition.

[2] Only two countries, the Republic of Korea and Japan, have managed to eradicate hunger and child undernutrition, while keeping adult overweight and obesity to a minimum (FAO and IFPRI, 2020, p.ix).

FIGURE A2.5 UNDERNUTRITION UP – OVERNUTRITION ALSO UP

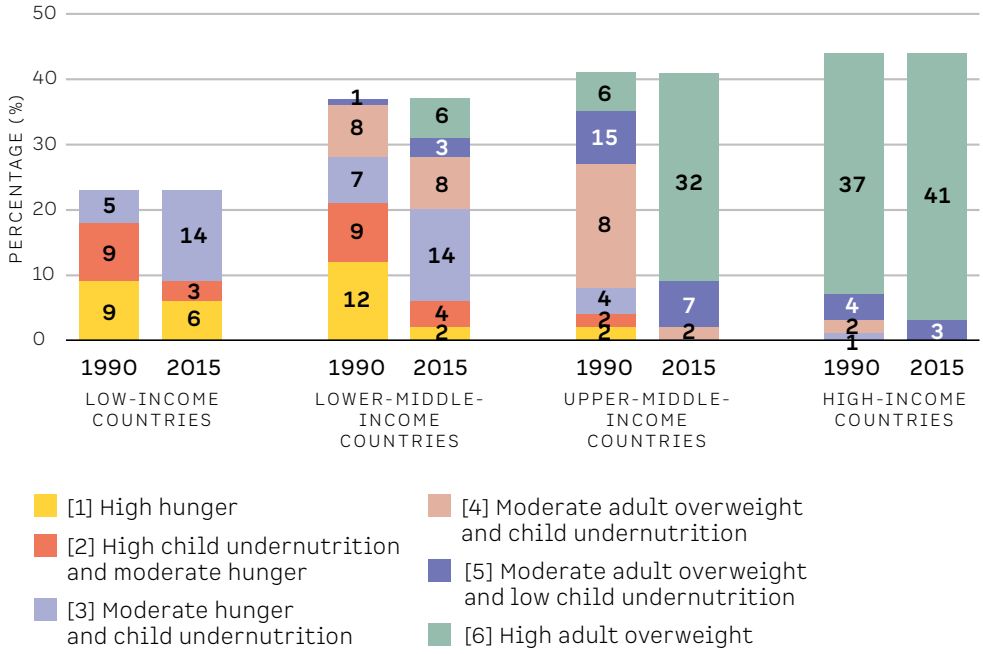


Source: https://www.foodsecurityportal.org/node/62.

During the 25-year period, the global progress made in reducing undernutrition has been accompanied by increasing overnutrition and obesity. Although 36 countries out of 145 have moved from categories that had higher levels of child undernutrition and hunger between 1990 and 2015 into categories 5 and 6, which have low or no child undernutrition, 53 were still dealing with child undernutrition in 2015. During this same period, the number of countries with a high prevalence of adult overweight and obesity increased from 43 to 79.

Using income-level groups, we are able to show in **FIGURE A2.6** how our different economies fare in these six different food security and nutrition situations.

FIGURE A2.6 NUMBER OF COUNTRIES IN FOOD SECURITY AND NUTRITION CLUSTERS BY INCOME LEVEL, 1990-2015



Source: Authors' elaboration based on https://www.foodsecurityportal.org/node/62.

Low-income countries are still battling with high levels of hunger and child undernutrition in 2015. High-income countries, on the other hand, have drastically shifted to high levels of adult overweight and obesity.

FIGURE A2.6 compares the number of countries in the six FSN types in 1990 and 2015 using the four income-level groups. The figure shows that as income increases, adult overweight becomes more prevalent. Hunger and child undernutrition is a problem in low-income countries and adult overweight is a problem in high-income countries. This means that middle-income countries – especially those in the lower-middle income group – carry the double burden of malnutrition.

Food availability and healthy diets

The previous section highlights the need to be producing and consuming more diverse and nutrient dense diets. In this section we focus on this aspect by showing the mismatch between a healthy diet and food that is available for consumption.

Information comes from the following sources:

EAT-Lancet Commission (2019). Food Planet Health: Healthy Diets From Sustainable Food Systems. *Summary Report of the EAT-Lancet Commission.*
https://eatforum.org/eat-lancet-commission/eat-lancet-commission-summary-report/

FAO (2020). The State of Food Security and Nutrition in the World (SOFI). FAO.
http://www.fao.org/publications/sofi/2020/en/

The targets for a planetary health diet have been adapted from EAT-Lancet Commission (2019, p. 10).[3] It is worth noting that the healthy diet targets do not aim to prescribe an exact diet. Instead, they outline the food groups and food intakes that, when combined in a diet, have empirically been shown to optimize human health. A more detailed analysis would require an adaptation to reflect the culture, geography and demography of the population and individuals. Therefore, the targets used here should be considered a benchmark for analysis.

The EAT-Lancet Commission (2019) planetary health diet has a slightly lower intake of macronutrients from animal sources than other diets as it takes into account the environmental cost of protein sources. Conversely, the recommended amount of protein from non-animal sources (such as legumes and nuts) is slightly higher.

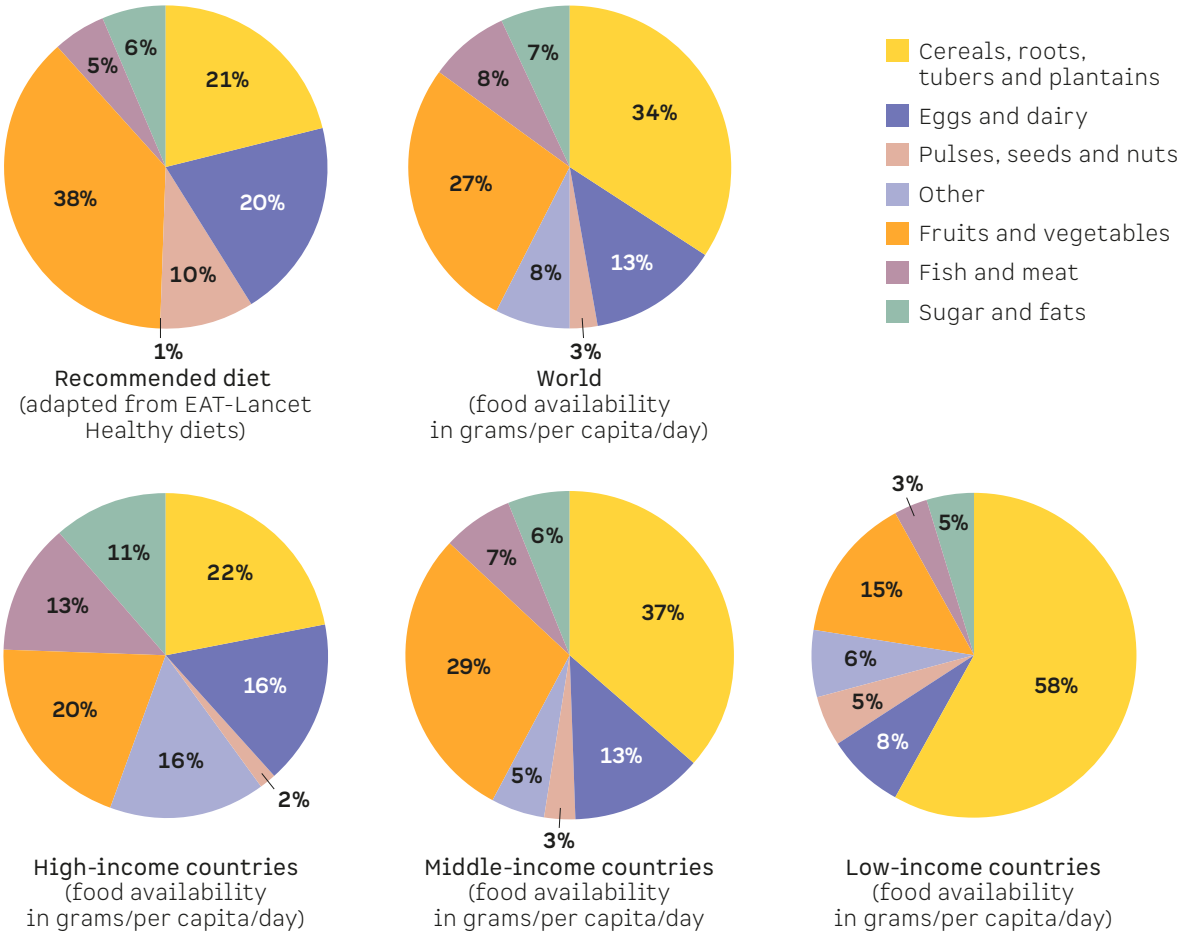
Data on food availability for human consumption globally and across different income groups have been adapted from FAO (2020), where estimations are based on the Supply Utilization Accounts (SUAs) database of the FAO Statistics Division (currently not in the public domain). Data from 184 countries and territories for the years 2000 to 2017 were used to estimate the contribution of all food groups (combined into seven groupings) to total food supply in grams per capita per day in 2017.[4]

In some cases, national SUAs may not reflect production from some small farms or private households. This caveat should be considered when using and interpreting SUA data.

We use these different sources to compare the targets of food consumption by food group for a planetary health diet with the availability of food (globally, and by income level). Data for middle-income countries have been estimated as an average of data for upper-middle-income and lower-middle-income countries. The results are presented in **FIGURE A2.7**.

3 Scientific targets set here are based on an extensive review of foods, dietary patterns and health outcomes.
4 For more information on the methodology and food categorization, see Annex 2 of FAO (2020).

FIGURE A2.7 COMPARING RECOMMENDED DIETS WITH FOOD AVAILABILITY GLOBALLY AND BY INCOME LEVEL



Sources: [1] EAT-Lancet Commission (2019). Food Planet Health: Healthy Diets From Sustainable Food Systems. Summary Report of the EAT-Lancet Commission.
https://eatforum.org/eat-lancet-commission/eat-lancet-commission-summary-report/.
[2] FAO (2020). The State of Food Security and Nutrition in the World (SOFI).
FAO. http://www.fao.org/publications/sofi/2020/en/.

Food availability worldwide does not match the recommended levels of food intake. This is especially true for cereals, roots, tubers and plantains, for which food availability is significantly greater than the recommended intake and for eggs and dairy, where there is a significant shortfall of availably to meet the recommended intake.

In low-income countries, the availability of cereals, roots, tubers and plantains is almost three times what is needed for a healthy and sustainable diet. In contrast, the availability of fruits and vegetables is two and a half times less than that required by the recommended diet.

In high-income countries, the availability of sugars and fats is almost double the recommended intake. The availability of pulses, seeds and nuts, on the other hand, is one fifth that of a healthy diet.

Globally, the availability of food for human consumption by different categories does not reflect the necessities for a healthy, sustainable diet. To achieve healthy and sustainable diets, global efforts should be directed not only to realign global production to effective needs, but particularly to ensure equal access to the diverse food groups to all. In 2017, cereals, roots, tubers and plantains represent the highest contribution to global total food availability (34 per cent), approximately 10 per cent more than actually required by healthy, sustainable diets. Fruits and vegetables, on the contrary, represent a smaller contribution (27 per cent), which is approximately 10 per cent less than needed to sustain healthy diets. Food availability is also deficient in pulses, seeds and nuts, and eggs and dairy.

Food availability versus food needs for a healthy diet is very different when looking at income levels. In low-income countries, cereals, roots, tubers and plantains represent nearly 60 per cent of all food available by weight in 2017, which is almost three times the actual needs for a healthy, sustainable diet. Fruits and vegetables, on the other hand, amount to only 15 per cent, which is about two and a half times less than the recommended intake.

The availability of food from animal sources (fish, meat, eggs and dairy) is higher in high-income countries, at 29 per cent, where only 25 per cent is needed for a healthy diet that requires other protein sources; and lower in low-income countries (11 per cent), where the availability of food from animal sources does not meet the requirements of a healthy, sustainable diet.

High-income countries have the highest availability of sugars and fats in proportion to other food groups (11 per cent) and 16 per cent of their food availability consists of sweetened and alcoholic beverages, juices, stimulants, spices and condiments, and sugar-preserved fruit. However, FAO (2020) states that high-income countries had the smallest increase in percentage change in the availability of sugars and fats in previous years, while the highest increase was seen in upper-middle-income countries.

5 Gender

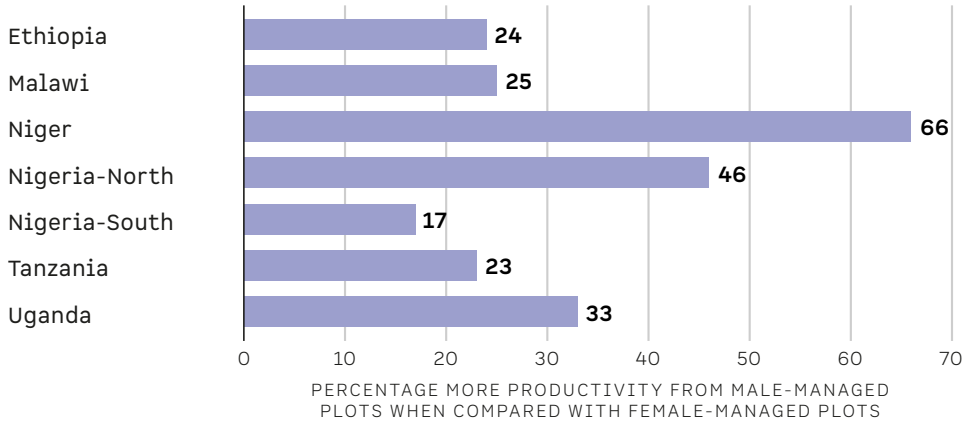
Gender productivity gaps

In 2014, the World Bank and the ONE Campaign produced a report that looked into the causes of gender gaps in farming productivity in six sub-Saharan African countries that comprise more than 40 per cent of the region's population. Data come from household surveys conducted in the late 2000s and early 2010s.

Integrated Surveys on Agriculture (LSMS-ISA). Analysis presented in World Bank and the ONE Campaign (2014) Levelling the Field. Improving Opportunities for Women Farmers in Africa.
https://www.worldbank.org/en/region/afr/publication/levelling-the-field-improving-opportunities-for-women-farmers-in-africa

The analysis shows that, when comparing simple averages, gender gaps in agriculture range from 13 per cent in Uganda to 25 per cent in Malawi. However, if the comparisons take into account plot size and geographic factors, gender gaps range from 23 per cent in Tanzania to 66 per cent in Niger. This suggests that, in Niger, plots managed by men of a similar size and in a similar geographic context to plots managed by women produce on average 66 per cent more per hectare. The results are presented in **FIGURE A2.8**.

FIGURE A2.8 GENDER GAPS IN AGRICULTURAL PRODUCTIVITY, CONTROLLING FOR PLOT SIZE AND SUBNATIONAL REGION



Note: The gap in southern Nigeria is not statistically significant, probably because of a relatively small sample size.
Source: Taken from World Bank, ONE Campaign (2014), p.9.

In similar contexts and similar sized-plots, men-managed plots produced between 24 per cent and 66 per cent more than women-managed plots.

The key factors correlated with gender productivity gaps were:

- Labour poses the main barrier to achieving equality in productivity across all the countries profiled
  - On average, female farmers tend to live in smaller households with fewer men. Consequently, they have fewer household members to provide labour on the farm.
  - Female farmers also face challenges in hiring effective outside labour.
  - Women typically assume a larger role than men in childcare and household responsibilities, which is likely to restrict their ability to work on their own farms or manage their labourers.
- There are significant differences in the use of and returns on inputs such as fertilizers.
- Women have less access and control over land, both of which are critical to agricultural investment.
- Women have less access to knowledge and information on farming methods.

Structural inequalities explain why plots managed by women cannot reach the same productivity levels as plots managed by men.

Agricultural wage gap

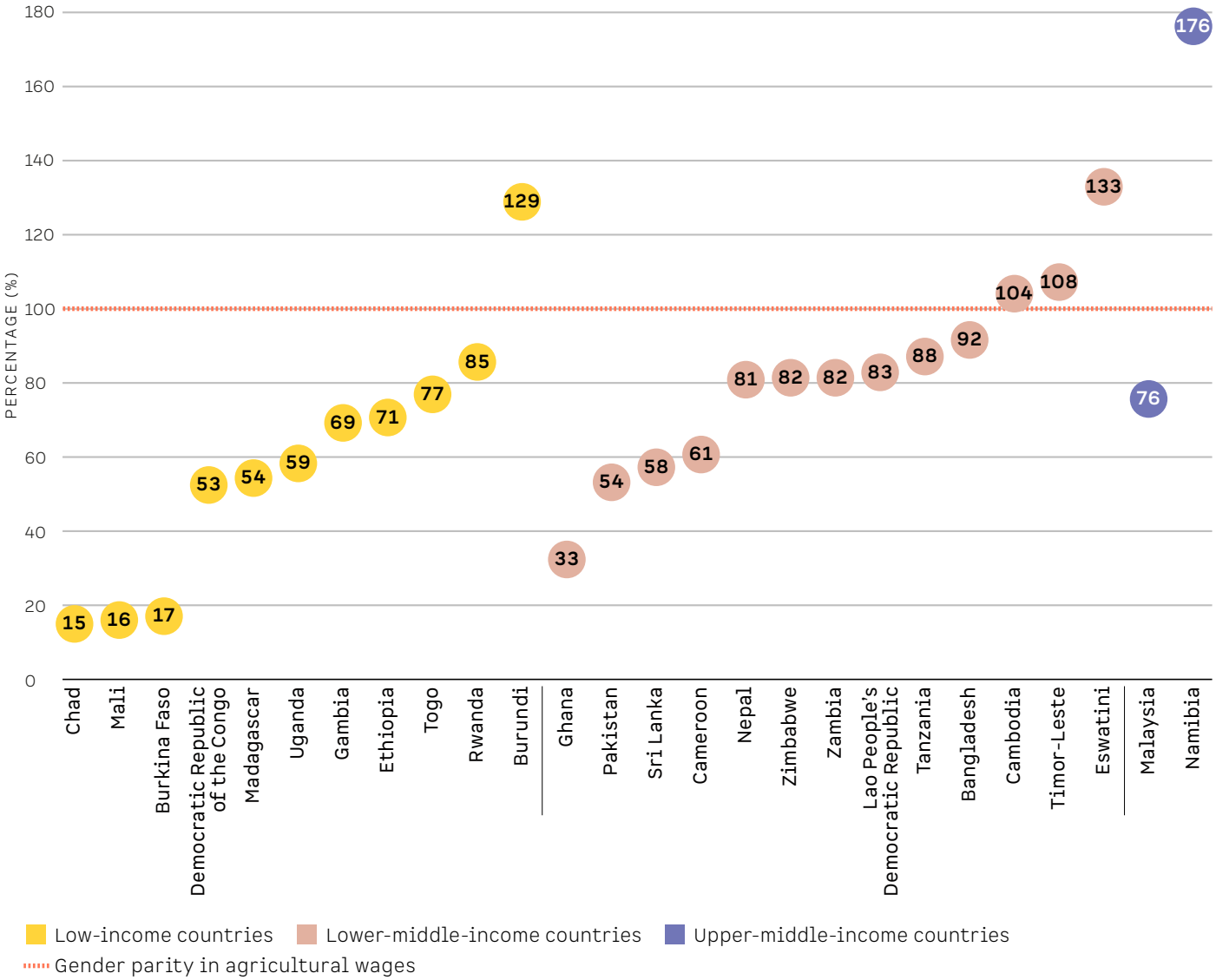
In this section we use data from the International Labour Organization (2019) to look at the agricultural wage gap (pennies on the dollar) for women's monthly earnings in agricultural employment compared with men's monthly earnings for our four-country categorization.

International Labour Organization (ILO) (2019). *Wages and working time statistics database.*

Available at: https://ilostat.ilo.org/data/. Calculations done by authors comparing average earnings for agriculture as an economic activity for men and women.

In all but a few countries, women earn less than men for work in the agricultural sector, though the gaps vary in size by country and by income level. On average, wage gaps are largest in low-income countries, with women earning as little as 15 cents for each dollar earned by men.

FIGURE A2.9 AGRICULTURAL WAGE GAP FOR WOMEN – SUBSTANTIAL AND PERSISTENT



Source: ILO, 2019.

6 Agrifood economy and employment

Agrifood systems employment: agriculture, food manufacture and food services

This section examines employment in the agrifood system (AFS). For this, we distinguish between employment in agriculture and non-farm AFS employment.

ILOSTAT (2021) Employment by sex and economic activity – ISIC level 2 (thousands). Downloaded from ILOSTAT. Last update on 7 March 2021.
https://ilostat.ilo.org/data/

As the ISIC differentiation does not allow for an easy extrapolation of retail employment in the food system (e.g. food markets) from other retail employment, the non-farm employment only includes workers in food, beverage and tobacco manufacturing and in food and beverage service activities, underestimating the food-related employment outside the farm gate.

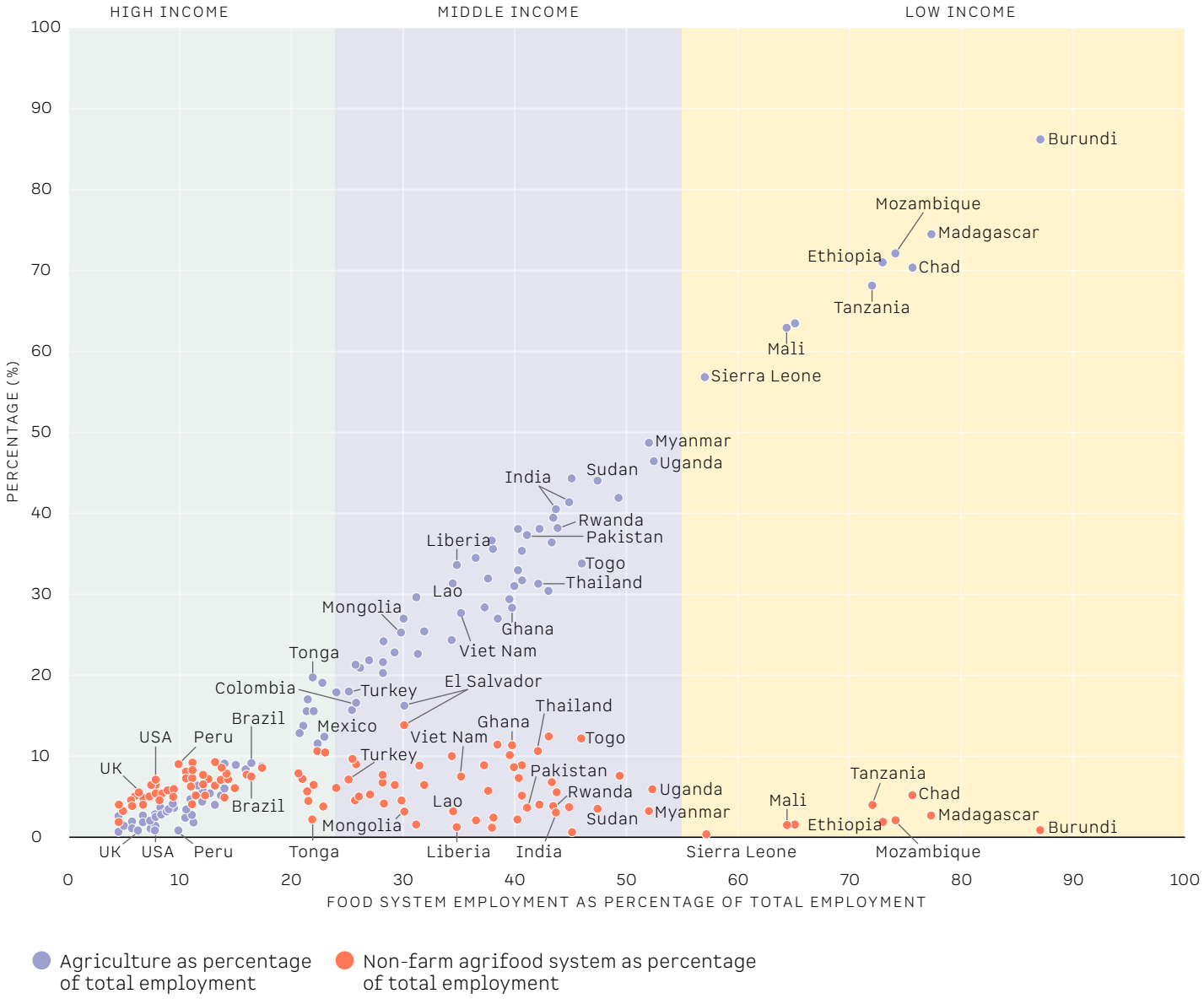
FIGURE A2.10 uses the latest data available from the ISIC level 2 ILO database for the year range 2012-2020. The Y axis shows the share of agricultural employment in total employment – blue dots – and the share of non-farm employment in total employment – orange dots. The X axis shows employment in food systems as a percentage of total employment.[5]

Countries with lower agricultural employment tend to have a lower share of employees in the general agrifood system. The lower the income, the higher the reliance on agriculture for employment. Non-farm employment slightly increases with income but does not seem to make a great difference in substituting the loss in agricultural employment. It is worth noting that data availability means that the non-AFS employment does not consider employment in food retail and, hence, employment in non-farm food-related activities may be underestimated.

Countries with a higher percentage of the population employed in food systems have higher agricultural employment. Generally, the lower the income level, the larger the proportion of employment in agricultural activities and the share of employment in food systems. Non-farm employment (manufacturing plus food and beverage service activities) does not seem to vary with income.

5 The share of employment in food systems is calculated as the sum of agricultural and non-farm AFS employment.

FIGURE A2.10 AGRICULTURAL AND NON-FARM EMPLOYMENT IN FOOD SYSTEMS AS PERCENTAGE OF TOTAL EMPLOYMENT (Y AXIS) WITH FOOD SYSTEMS EMPLOYMENT AS PERCENTAGE OF TOTAL EMPLOYMENT (X AXIS) (LATEST DATA, 2012-2020)



Agrifood system employment: comparing East and Southern Africa, India, Brazil, and the United States of America

This section examines employment in the agrifood system in four geographic areas: East and Southern Africa, India, Brazil, and the United States of America. Shares of employment in agriculture, food manufacture, food services and retail and other sectors are presented both as a percentage of food system employment and as a percentage of total employment. This section takes a more comprehensive look at food systems by including employment in food markets and retail.

For Brazil: Moreira et al. (2016) Assessment of the Economic Structure of Brazilian Agribusiness (table 4).
https://www.hindawi.com/journals/tswj/2016/7517806/

For East and Southern Africa: Tschirley et al. (2015) Africa's unfolding diet transformation: implications for agrifood system employment (p.108)
https://www.emerald.com/insight/content/doi/10.1108/JADEE-01-2015-0003/full/html (based on LSMS surveys in Ethiopia, Malawi, Mozambique, Tanzania, Uganda and Zambia).

For India: Data on agriculture, food manufacture, and total employment from LOSTAT (2021) Employment by sex and economic activity – ISIC level 2 (thousands). Downloaded from ILOSTAT. Last update on 7 March 2021.
https://ilostat.ilo.org/data/; and total amount of non-farm employment from Can India's 21 million food enterprises withstand the impact of COVID-19?, Working paper.

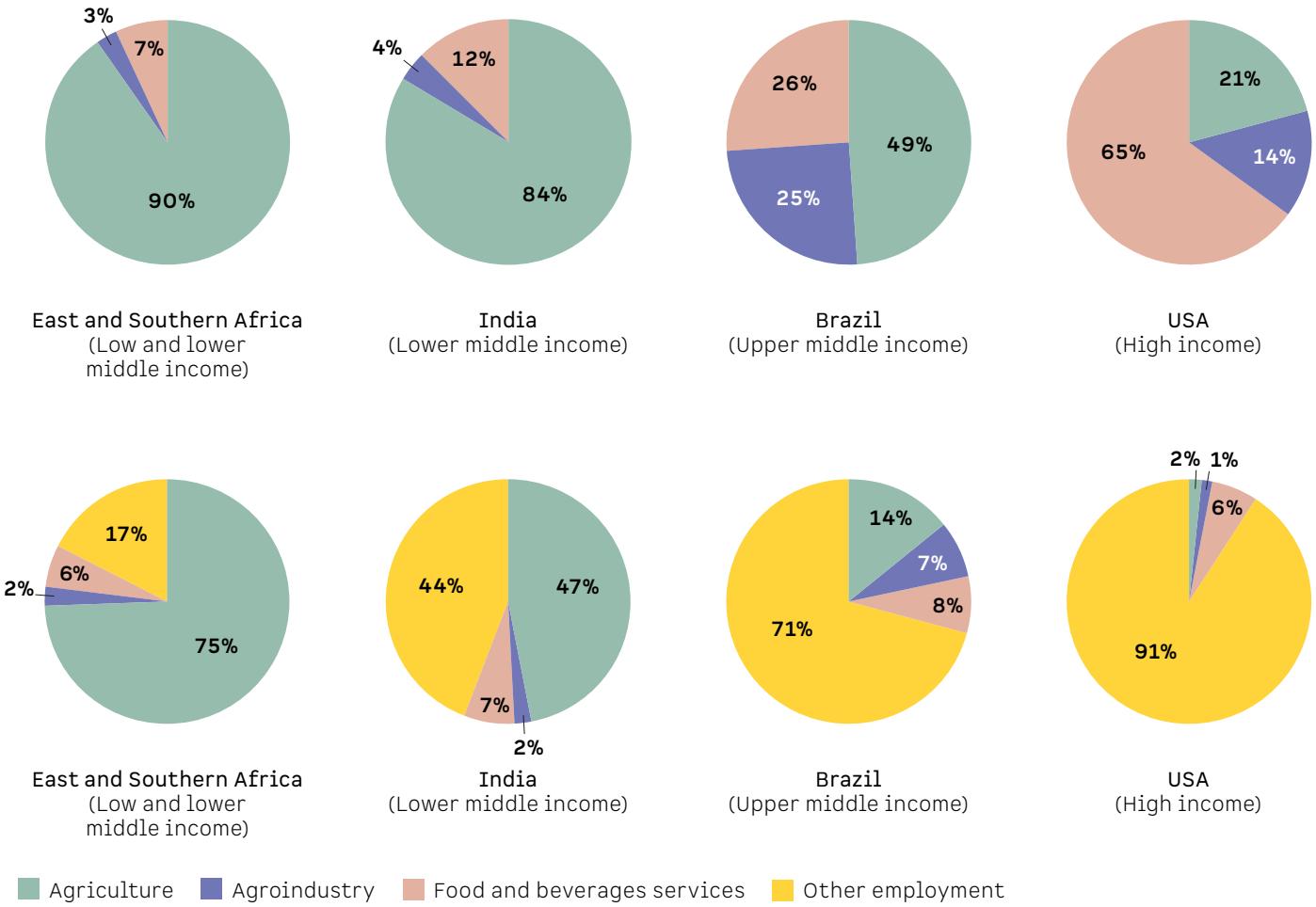
For United States of America: USDA (2012). Agriculture and its related industries provide 9.2 per cent of U.S. employment.
https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=77216

Non-farm employment (in manufacturing and food services and retail) as a share in the food system becomes increasingly prevalent when the level of income increases. However, as a share of total employment, non-farm employment remains significant in low- and middle-income countries (in India with 56 per cent and Brazil with 29 per cent). This suggests that food systems provide significant employment opportunities outside the farm gate.

In low- and lower-middle-income countries, food systems provide important employment opportunities outside the farm gate.

FIGURE A2.11 INDICATIVE DISTRIBUTION OF EMPLOYMENT IN THE FOOD SYSTEM IN SELECTED AREAS AT DIFFERENT INCOMES COMPARED WITH DISTRIBUTION AS PART OF TOTAL EMPLOYMENT

AS A SHARE OF FOOD SYSTEM EMPLOYMENT



Note: Data are from 2010 for East and Southern Africa, from 2011 for Brazil, and from 2012 for India and USA.

Time allocation in agrifood employment by geographic region

This section examines employment in the agrifood economy in 13 countries in Asia, sub-Saharan Africa and Latin America by measuring the time spent in any economic activity or job. It uses the concept of full-time equivalent (FTE). Data come from household surveys (Living Standards Measurement Studies [LSMS] and national surveys) and are presented in Dolislager et al. (2019).

For data: Dolislager et al. (2019) Youth agrifood system employment in developing countries: a gender differentiated spatial approach, Research Series 43, IFAD
https://bit.ly/3bhK5aW

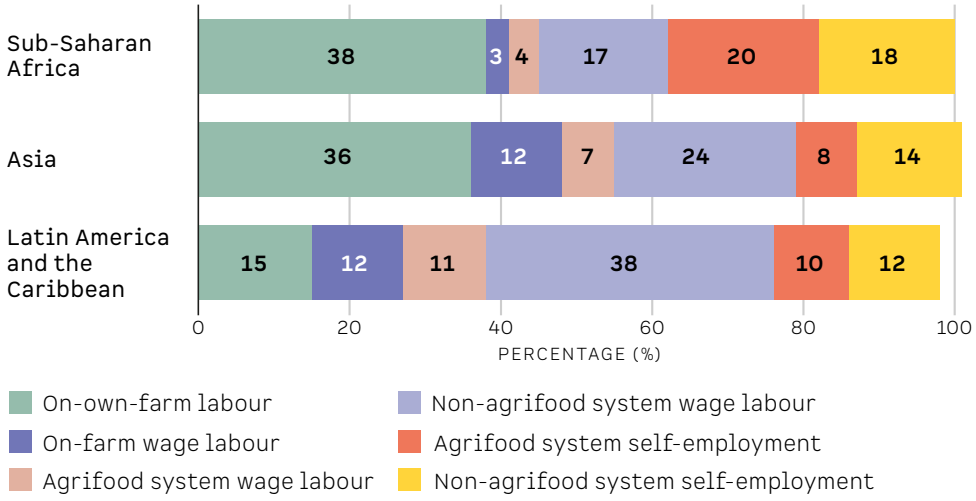
LSMS data have been collected in Ethiopia, Malawi, Niger, Nigeria, Tanzania and Uganda for sub-Saharan Africa; Bangladesh, Cambodia, Indonesia and Nepal for Asia; and Mexico, Nicaragua and Peru for Latin America.

The analysis considers time spent in economic activities or jobs in farms, non-farm in the AFS; and other non-agrifood-related activities. AFS employment is employment in agricultural and food product processing, logistics, wholesale, retail, and food service (such as food stalls), other than on-farm production.

The main categories are further divided into "own" economic activities in self-employment or family activities; and "wage" jobs carried out in economic activities owned by others.

Dolislager et al. (2019) divided the population densities of the 13 study countries into quartiles that represent rural-urban gradients (four zones). The densest quartile represents urban areas. The rural areas are split into the second densest zone (peri-urban), the third densest (intermediate), and the least dense (hinterland). We combined the three least dense quartiles (peri-urban, intermediate and hinterland) in an average to estimate the time allocation in different work activities in rural areas. The results are presented in **FIGURE A2.12** and **FIGURE A2.13**.

FIGURE A2.12 ESTIMATED TIME ALLOCATION BY LABOUR CATEGORY IN RURAL AREAS, BY GEOGRAPHIC REGION SYSTEM



Notes: [1] Agrifood system employment is all other food system activities other than on-farm production.
[2] The figures are population weighted estimates from household surveys in 13 countries detailed above.
Source: Authors' elaboration based on Dolislager et al. (2019).

Latin America and the Caribbean is the region where the rural labour force spends comparatively less time in agrifood-related activities (48 per cent); in Asia and sub-Saharan Africa time spent by the labour force on agrifood-related activities amounts to 63 per cent and 65 per cent, respectively.

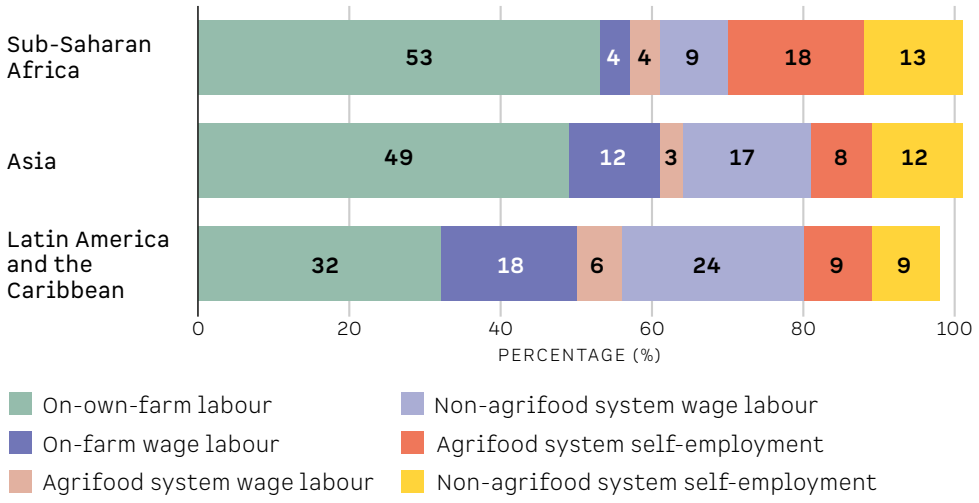
The amount of time spent on own-farm labour is similar in rural areas in sub-Saharan Africa and Asia – but more than double than time spent by the labour force on own farms in countries of Latin America and the Caribbean.

Although the percentage of time spent on farm work is much lower in rural areas of Latin America and the Caribbean (27 per cent compared with 41 per cent in sub-Saharan Afria and 48 per cent in Asia), time spent on non-farm AFS activities is comparable to, or higher than, that of the other regions (21 per cent, compared with 24 per cent in sub-Saharan African and 15 per cent in Asia). According to Dolislager et al. (2019), "this suggests that even as rising agricultural productivity in richer countries sends labour off the farm, and non-AFS sectors begin to dominate employment opportunities, increased value in off-farm AFS subsectors can continue to provide employment opportunities."

FIGURE A2.13 shows the breakdown of labour time allocation in the hinterlands defined by the authors as the least densely populated quartile in each survey. In the hinterlands, individuals spend more of their time in agrifood system-related activities. Work in the agrifood system accounts for 79 per cent of labour time in sub-Saharan Africa, 72 per cent in Asia and 65 per cent in Latin America and the Caribbean.

The labour force in the hinterland of all three regions spends a significant amount of time in farming and agrifood-related activities, the highest being in sub-Saharan Africa (87 per cent) and the lowest in Asia (70 per cent).

FIGURE A2.13 TIME ALLOCATION BY LABOUR CATEGORY WITHIN AND OUTSIDE THE FOOD SYSTEM IN THE HINTERLANDS



Source: Authors' elaboration based on Dolislager et al. (2019).

7 Rural household economic and employment diversification

Rural household income diversification

Rural household diversification data come from the Rural Household Multiple Indicator Survey (RHoMIS), a dataset containing information on 13,310 farm households in 21 countries gathered through a standardized questionnaire.

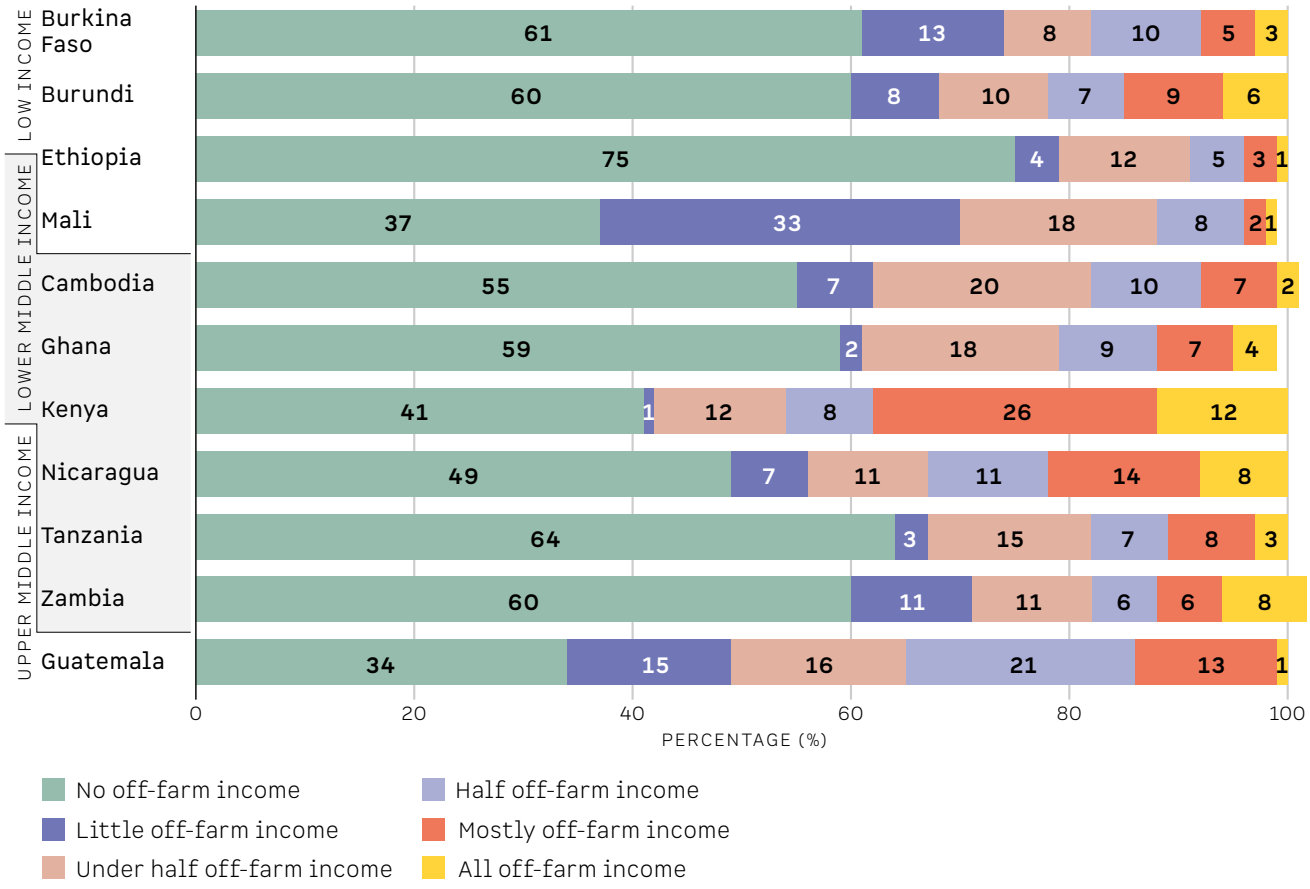
Rural Household Multiple Indicator Survey (RHoMIS)
https://doi.org/10.7910/DVN/9M6EHS

We analysed the raw data, specifically looking at the variables related to off-farm income. The survey asks respondents about the proportion of their total household income that comes from off-farm sources, and gives respondents five categories from which to choose: all (90 per cent or more), most (70-89 per cent), half (50-69 per cent), under half (11-49 per cent) and little (10 per cent or less). Further variables derived by the RHoMIS team operationalize these numerically into the following values: all (90), most (70), half (50), under half (20), little (10).

Except for Guatemala, all the countries in **FIGURE A2.14** are either low-income or lower-middle-income countries. Rural households in this sample report that at least one third of their income comes from no off-farm activities, the highest being in Ethiopia, with 75 per cent of rural households' income. The figure also shows that a minority of rural households, in low- and lower-middle-income countries alike, derive all of their income from off-farm sources, the highest being Kenya, with 12 per cent of households' incomes.

The figure highlights the importance of own-farm income for most rural households in the sample.

FIGURE A2.14 INCOME FROM OFF-FARM SOURCES IN RURAL HOUSEHOLDS IN SELECTED COUNTRIES (%)



Source: Authors' elaboration based on Rural Household Multiple Indicator Surveys.

Income sources for smallholders

Data come from FAO's data portrait of small family farms, which uses household surveys for 19 countries across the world to generate an image of how family farmers in developing and emerging countries live their lives. With the exception of Ethiopia, which uses the Ethiopian Rural Household Survey, all the surveys are nationally representative and cover urban and rural areas. Data are reported for smallholders, other (larger-scale) holders and all farmers.

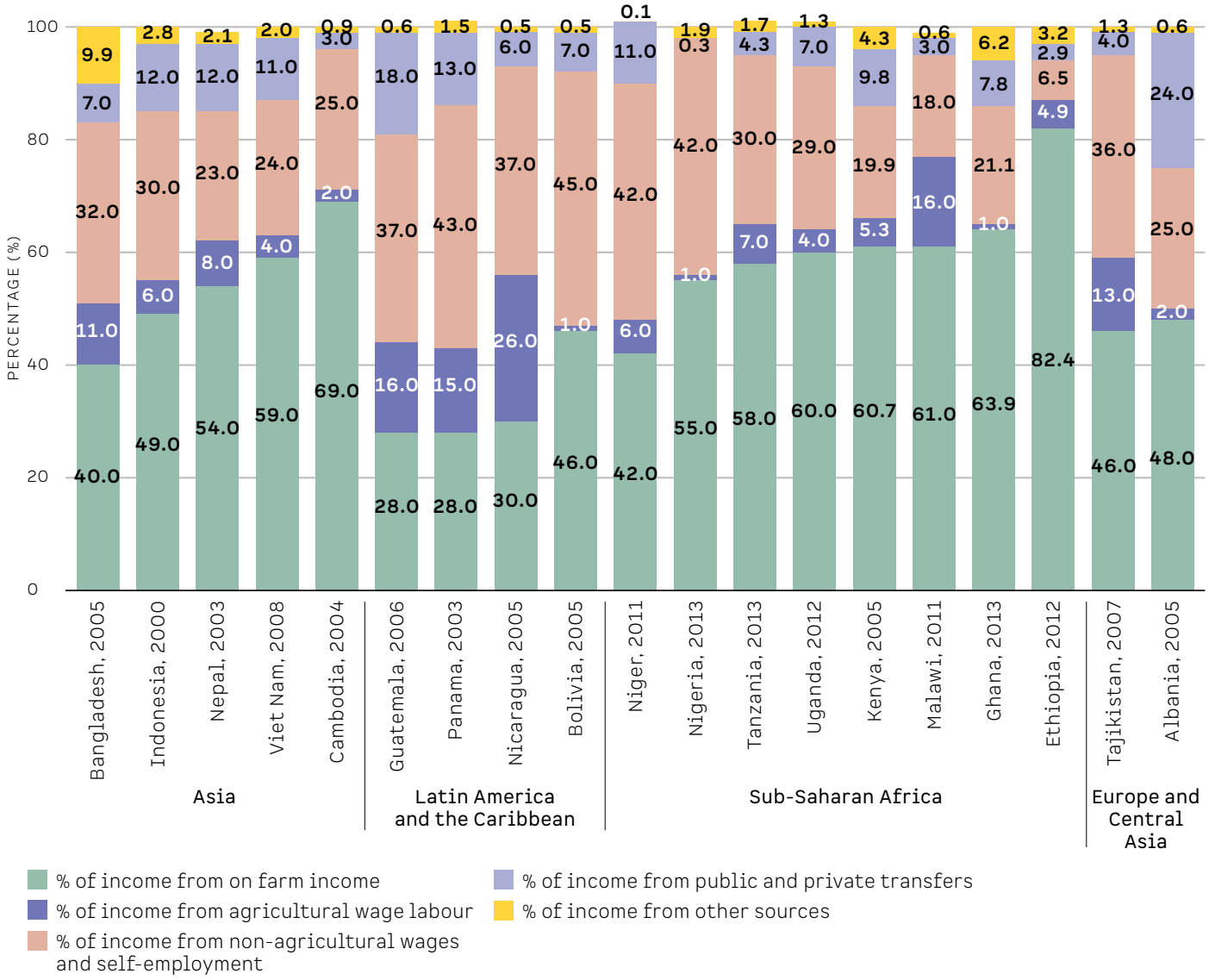
Family Farming Knowledge Platform: Smallholders Data Portrait
http://www.fao.org/family-farming/data-sources/dataportrait/income/en/

In **FIGURE A2.15** we show income sources for all farmers (not only small-scale farmers) using the following categories:

- Percentage of income from on farm income: this is the share of income from farm activities, which are crop production, crop by-products (only when it is possible to distinguish these from crop production), livestock and livestock by-products production.
- Percentage of income from agricultural wage labour: this is the share of income from paid dependent work in agriculture, both skilled and unskilled.
- Percentage of income from non-agricultural wages and self-employment: this is the share of income from non-farm sector, including both wages from non-agricultural employment and non-farm self-employed business income.
- Percentage of income from transfers, remittances: this is the share of income from private and public transfers, including pensions and social assistance.
- Percentage of income from other sources: this is the share of income from other miscellaneous sources including, for example, farm and non-farm rental income, real estate income, savings, interest or other investment income.

Most of the income of small-scale farms in sub-Sahara Africa comes from farm and agriculture labour, whereas in Latin America and the Caribbean, small-scale farms derive most of their income from non-farm and non-agricultural activities.

FIGURE A2.15 FAMILY FARMERS' INCOME SOURCES IN SELECTED COUNTRIES



Source: Authors' elaboration using data from Data Portrait of Small Family Farms.

8 Digital

In this section we focus on the digital divide and differences in rates of technological development.

GSMA Intelligence 2020. *The State of Mobile Internet Connectivity 2020*
https://www.gsma.com/r/wp-content/uploads/2020/09/GSMA-State-of-Mobile-Internet-Connectivity-Report-2020.pdf

Multiple factors need to be considered when assessing the digital divide and differences in rates of technological development. With the increasing extension of infrastructure, and the number of people living in an area without coverage of a mobile broadband network amounting to only 7 per cent (or half a billion people) in 2019, the coverage gap is not the main determinant in the access and use of digital services.

Geographical location, rural-urban areas and gender play a key role in the digital usage gap. Globally, rural populations are still 37 per cent less likely than urban populations, and women are still 20 per cent less likely than men to use mobile internet access. The gap is more accentuated in countries with lower levels of income.

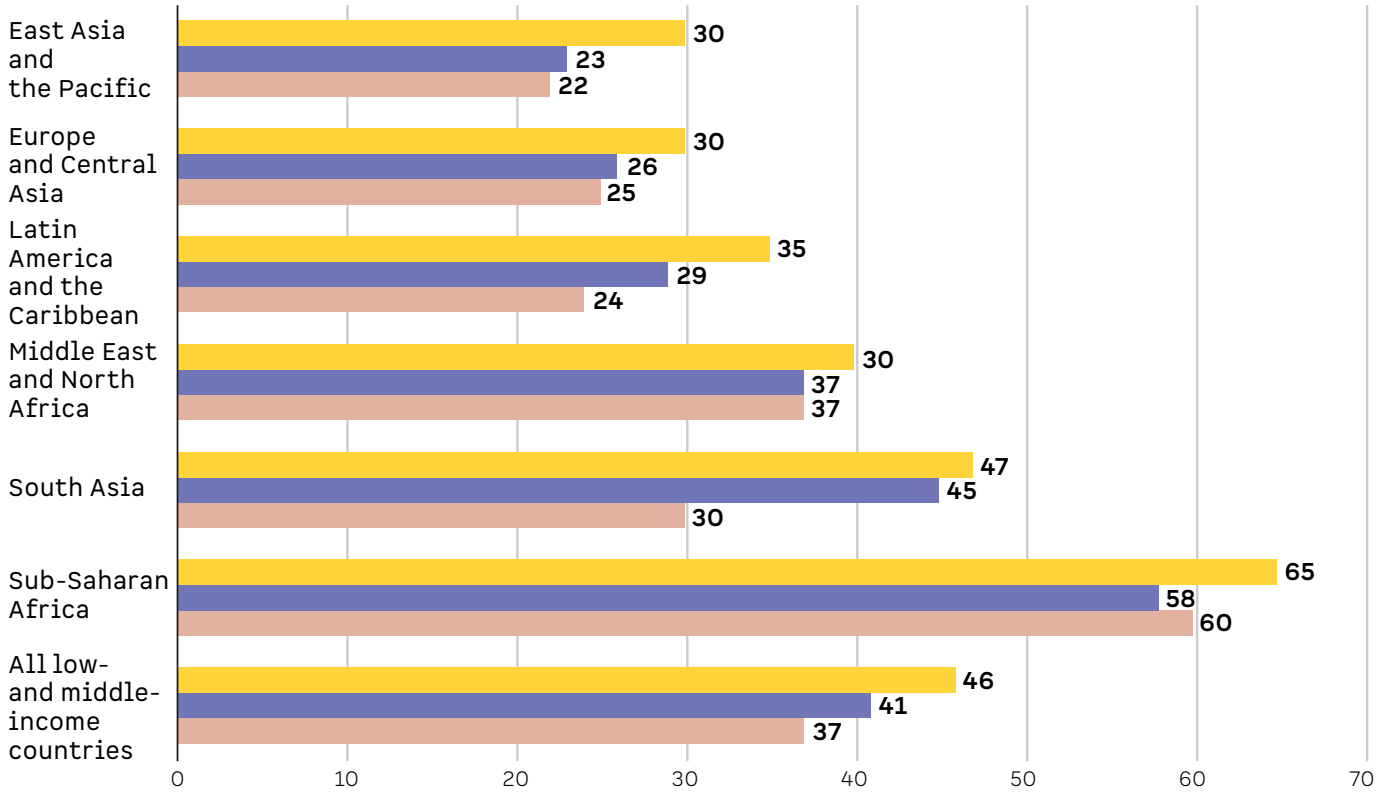
Affordability, awareness and digital literacy play a key role in internet use. In low- and middle- income countries, handset affordability remains the main barrier to mobile ownership, while nearly 25 per cent of adults are not aware of mobile internet. Digital literacy and skills are more likely to be perceived as the most important barrier to adoption in rural populations when compared with urban, and among women when compared with men. Similarly, women are more likely than men to perceive skills as the most important barrier to mobile internet adoption, especially in Africa.

By geographic region in low- and middle-income countries

FIGURE A2.16 shows the rural-urban gap in mobile internet use. The gap refers to how much less likely a person living in a rural area is to use mobile internet than a person in an urban area.

The rural-urban gap in mobile internet adoption is reducing but remains substantial. The reduction was driven primarily by an improvement in South Asia, where the gap fell from 47 per cent to 30 per cent between 2017 and 2019.

FIGURE A2.16 RURAL-URBAN GAP IN MOBILE INTERNET USE IN LOW- AND MIDDLE-INCOME COUNTRIES, BY REGION, 2017-2019 (%)



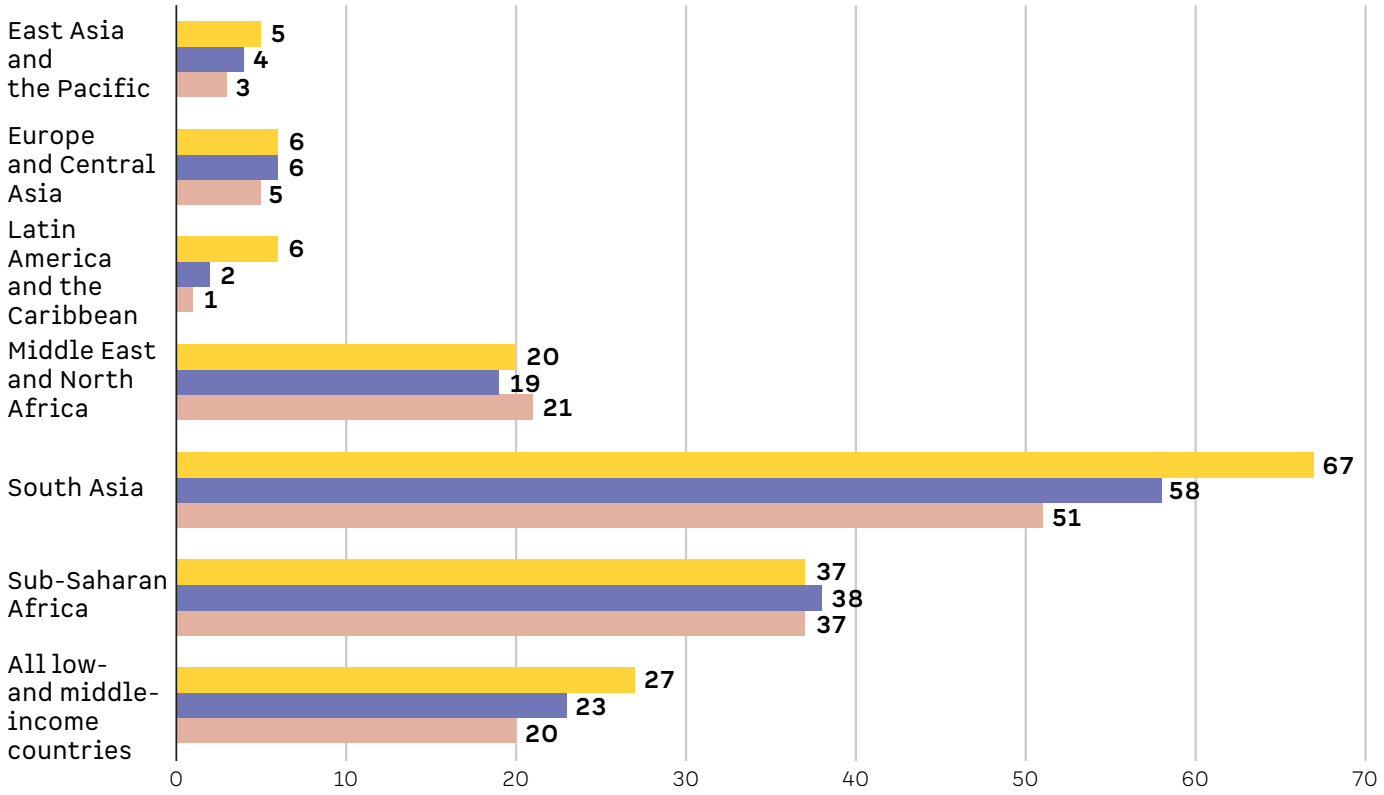
Source: Reproduced from The State of Mobile Internet Connectivity 2020, (p. 19).

By gender in low- and middle-income countries

The gender gap in mobile internet use is largest in South Asia, but this is also the region with the greatest improvement between 2017 and 2019. On the other hand, the gap in sub-Saharan Africa and in the Middle East and North Africa shows no change in the same period.

Despite an overall reduction in the gender gap of mobile internet use in low- and middle-income countries from 27 per cent to 20 per cent, there are still more than 300 million fewer adult women than men using mobile internet.

FIGURE A2.17 GENDER GAP IN MOBILE USE IN LOW- AND MIDDLE-INCOME COUNTRIES, BY REGION, 2017-2019 (%)



Source: Reproduced from The State of Mobile Internet Connectivity 2020, (p. 20).

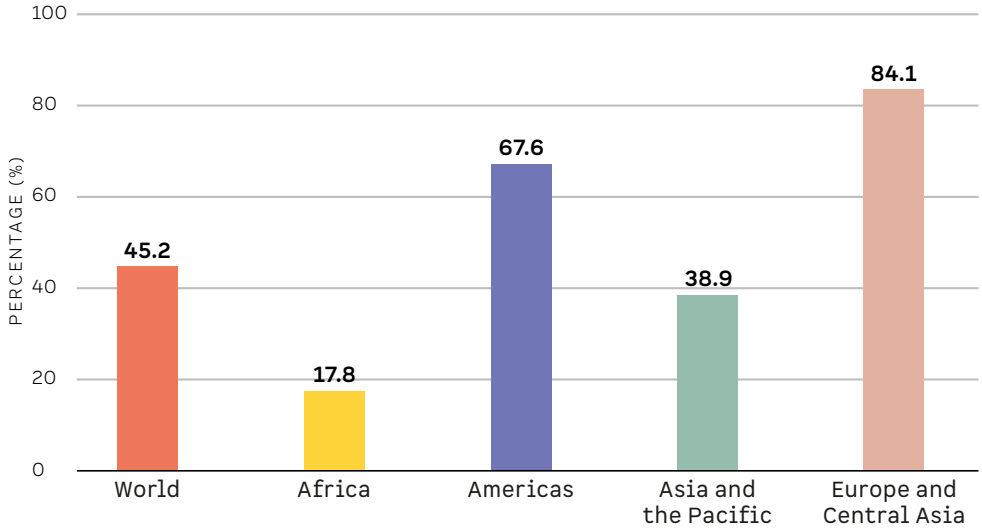
9 Social protection

By geographic regions

The data in **FIGURE A2.18** come from the ILO World Social Protection Database. Social protection benefits (SDG indicator 1.3.1) include benefits for children, mothers with newborns, persons with severe disabilities, unemployed people, older people, and vulnerable people covered by social assistance. Coverage means either receiving a cash benefit or contributing to a social security scheme.

World Social Protection Report 2017-2019: Universal social protection to achieve the Sustainable Development Goals.
https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_604882.pdf

FIGURE A2.18 PROPORTION OF POPULATION COVERED BY AT LEAST ONE SOCIAL PROTECTION BENEFIT



Source: ILO, 2017.s.

In sub-Saharan Africa and Asia and the Pacific, well under half of the population have coverage from even one social protection benefit.

Only two out of 10 people in Africa are covered by at least one social protection benefit.

By income level

Using the same information, in **FIGURE A2.19** we show levels of social protection coverage disaggregated by country and by income level. For each of the income groups, we show the median of the proportion of population covered by at least one social protection benefit.

FIGURE A2.19 PROPORTION OF POPULATION COVERED BY AT LEAST ONE SOCIAL PROTECTION BENEFIT, BY TYPE OF ECONOMY

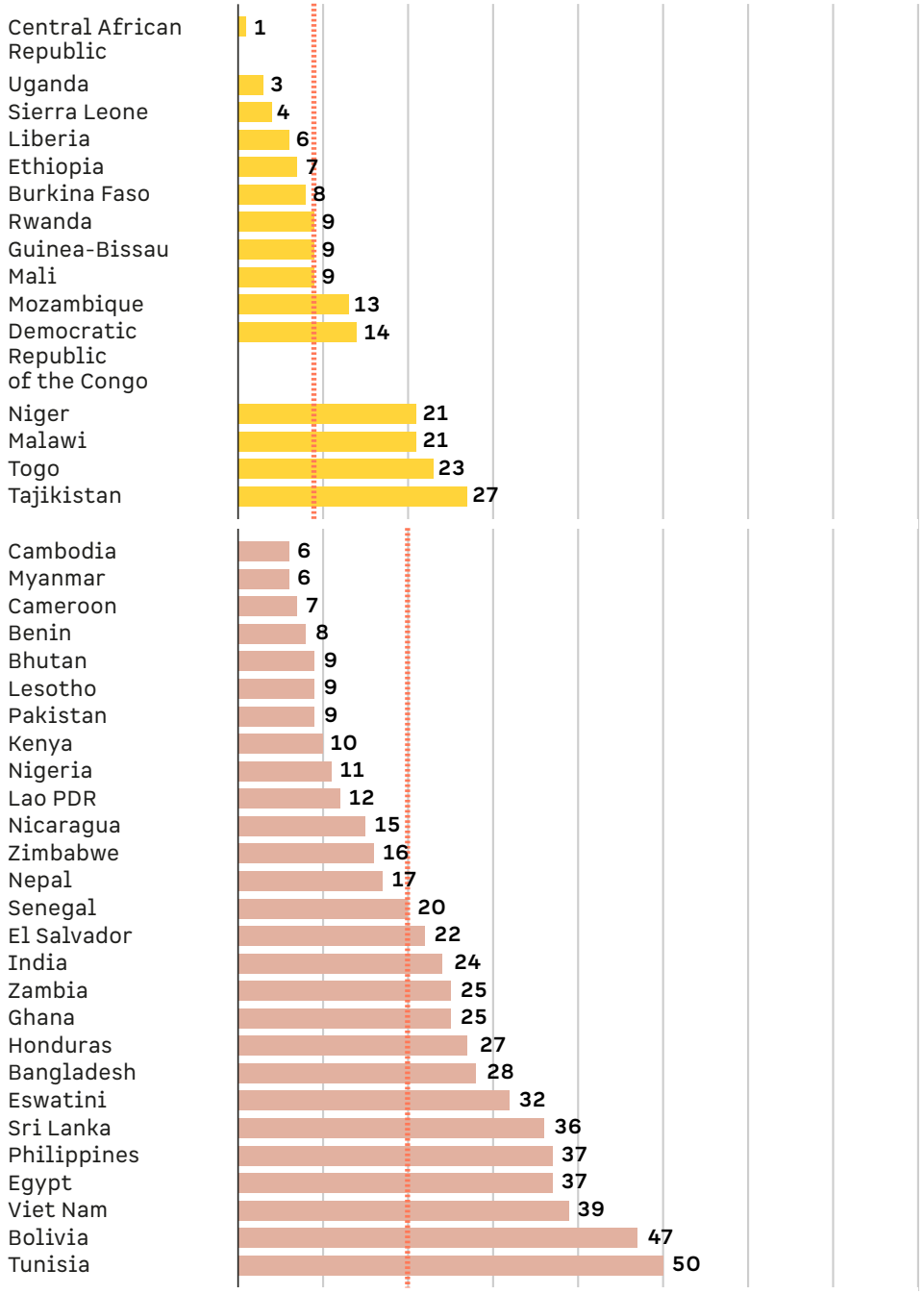
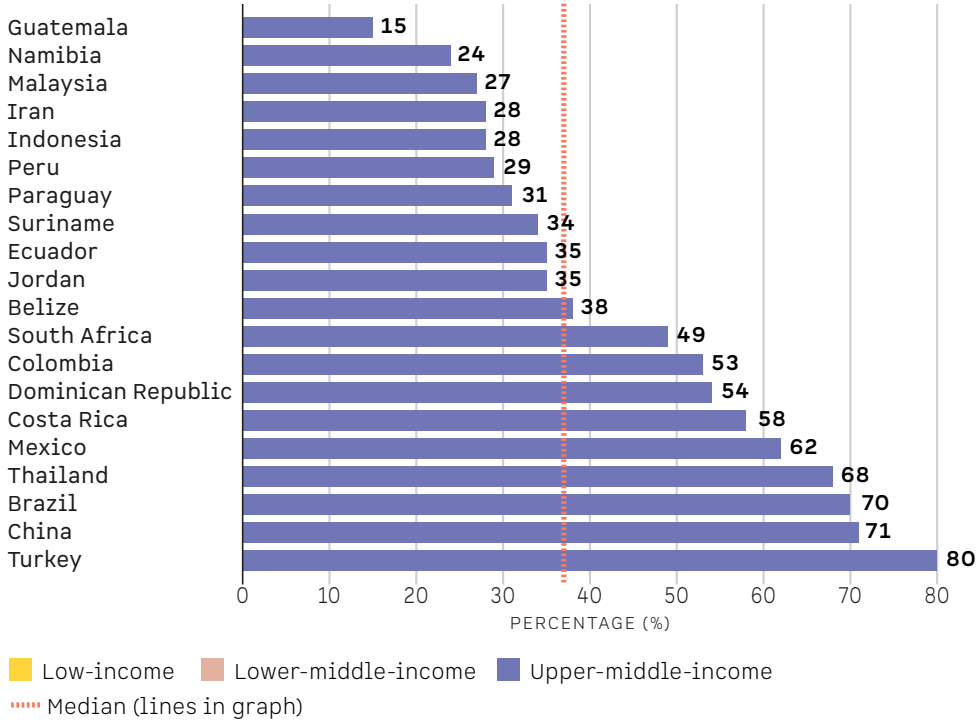


FIGURE A2.19 (CONT.)



Source: Authors' elaboration based on World Social Protection Report 2017-2019: Universal social protection to achieve the Sustainable Development Goals.

Upper-middle-income countries have the highest proportion of their populations covered by at least one social protection benefit (with a median coverage of 37 per cent), as opposed to low-income countries, which have the lowest (with a median coverage of 9 per cent).

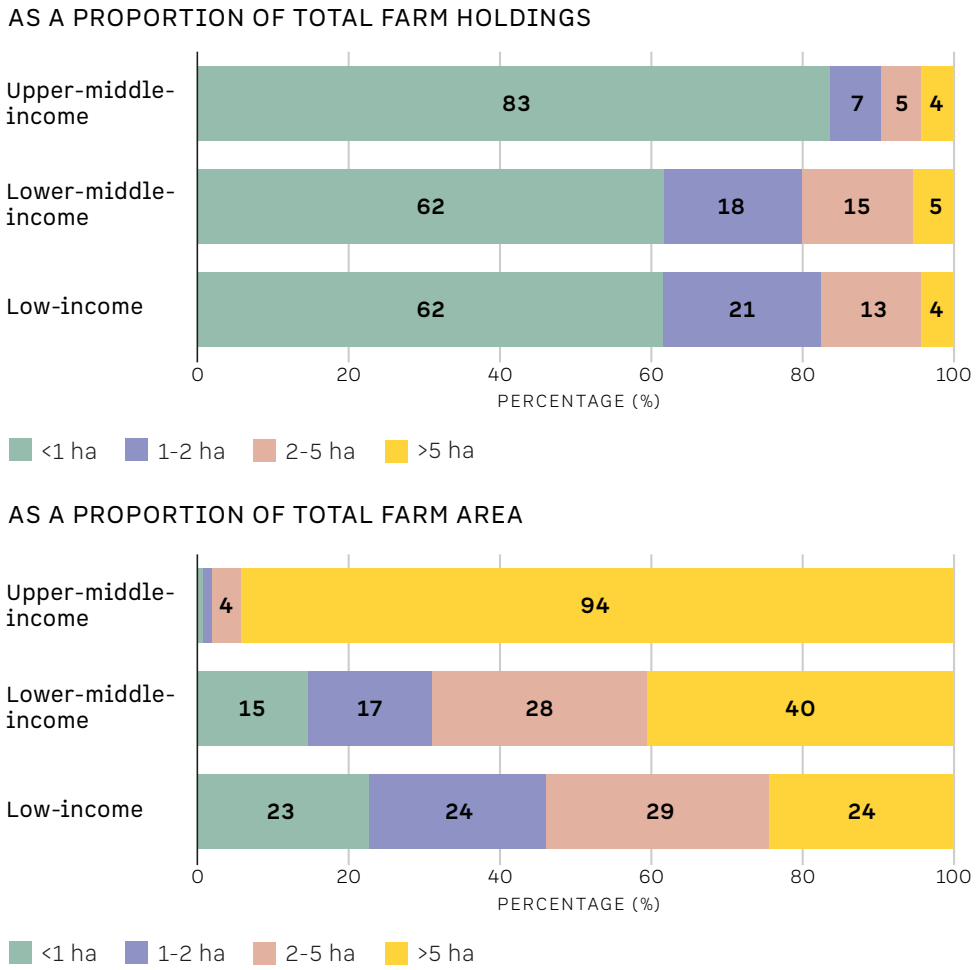
None of the low-income countries have coverage as high as the median for upper-middle-income countries.

10 Small-scale agriculture

Data compiled by Lowder et al. (2016). https://www.sciencedirect.com/science/article/pii/S0305750X15002703 (see supplementary data, accessed April 2021).

Data are originally from national agricultural censuses and span years from early 1990s to early 2010s.

FIGURE A2.20 DISTRIBUTION OF FARMS BY SIZE AS A PROPORTION OF TOTAL FARM HOLDINGS AND FARM AREA

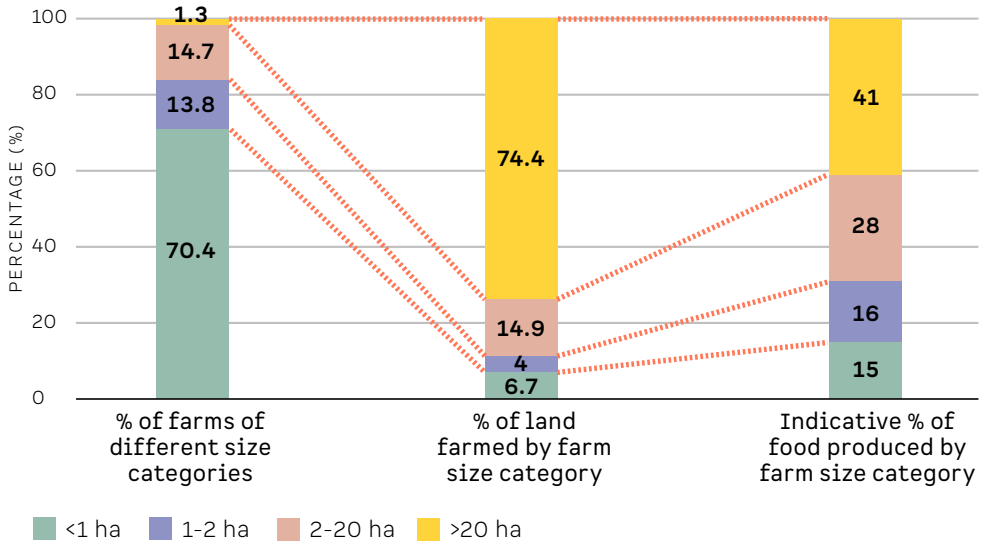


Note: Number of countries in each income group varies.

Very small holdings (<1 ha) account for the majority of farms in all income groups. Still, they hold under one quarter of the land in low-income countries, and almost no land (1 per cent) in upper-middle-income countries.

Smallholders are being squeezed, and the farm sector is bifurcating in terms of farm size, with larger farms being owned by relatively few individuals and yet occupying outsize proportions of land.

FIGURE A2.21 INDICATIVE RELATIONSHIPS BETWEEN FARM SIZE CATEGORY, AREAS OF LAND FARMED AND FOOD PRODUCTION



Source: Table 3.

Very small holdings (<1 ha) constitute the majority of farms yet they hold 7 per cent of the land and produce over one tenth of the food. Large holdings (>20 ha), on the other hand, constitute 6 per cent of the total holdings yet they account for 80 per cent of the land area and produce almost half (47 per cent) of the total food.

11 Ease of doing business and enabling the business of agriculture

World Bank (2019). Enabling the Business of Agriculture. (Accessed: February 2021).
https://eba.worldbank.org/en/eba

World Bank (2020). Ease of Doing Business Scores. (Accessed: February 2021).
https://www.doingbusiness.org/en/data/doing-business-score

Ease of doing business. An economy's ease of doing business score is reflected on a scale of 0 to 100, where 0 represents the lowest performance and 100 represents the best performance. The ease of doing business score measures an economy's performance with respect to a measure of regulatory best practice across the entire sample of 41 indicators for 10 doing business topics. For more information on the ease of doing business score methodology, see World Bank (2020).

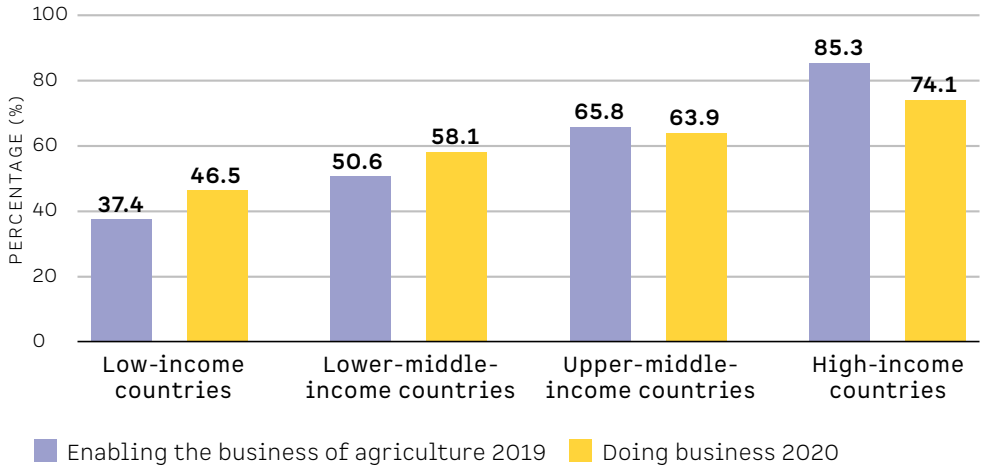
Enabling the business of agriculture. Enabling the business of agriculture presents indicators that measure the laws, regulations and bureaucratic processes that affect farmers in 101 countries. The eight core indicators are: supplying seed, registering fertilizer, securing water, registering machinery, sustaining livestock, protecting plant health, trading food and accessing finance. For more information on the enabling the business of agriculture score methodology, see World Bank (2019).

FIGURE A2.22 shows the average ease of doing business scores of 189 countries in 2020 and the average enabling the business of agriculture scores of 101 countries in 2019 by income levels as classified by the World Bank.

Both the ease of doing business and enabling the business of agriculture scores are generally higher for countries at higher income levels. Regulators in low- and middle-income countries should work towards an enabling environment for businesses to grow and flourish.

Low-income countries face more challenges when doing business, including in the agricultural sector.

FIGURE A2.22 DOING BUSINESS IS MORE DIFFICULT IN LOW- AND MIDDLE-INCOME COUNTRIES



Source: World Bank 2019, 2020a, 2020c.

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